

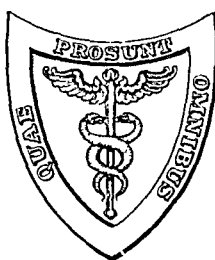
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GEORGE MORRIS PIERSOL, M.D.

JOHN H. MUSSER, JR., M.D.
ASSISTANT EDITOR

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THE
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ORIGINAL ARTICLES

THE MANAGEMENT OF POSTPNEUMONIC EMPYEMA BASED
UPON 310 CASES.

BY WILLARD J. STONE, M.D., MAJOR, M.C., U.S.A.,

TOLEDO, OHIO;

CHIEF OF MEDICAL SERVICE, U. S. A. BASE HOSPITAL, FORT RILEY, KANSAS.

AMONG approximately 4000 patients with pneumonia, empyema necessitating repeated aspirations or operation has occurred in 310. The actual incidence of empyema in pneumonia has, however, been higher in this locality than these figures indicate. In many patients with a rapidly spreading pneumonia leading to a fatal outcome in three or four days, empyema was diagnosed prior to death. The advisability of operation upon these patients was not considered, nor have they been included in this report. During the epidemic of measles and pneumonia at the Fort Riley Reservation, which occurred in the fall and winter of 1917-1918, during the epidemic of streptococcus pneumonia which occurred during March and April, 1918, as well as during the epidemic of influenzal pneumonia, September 15 to November 1, 1918, a sufficient amount of purulent fluid in the thorax to warrant the use of the term, empyema, could be determined prior to death in many patients. In fact, exudation of serous and later of seropurulent fluid, in greater or lesser amount, into the pleural cavities took place so frequently in these extensive epidemic pneumonias that its occurrence might be considered almost the rule rather than the exception. In many such patients death occurred so rapidly that the presence of fluid was looked upon as an incident rather than the determining factor in producing death.

Depending upon the locality, the etiological factors producing pneumonia may be expected to show variation. From experience in army base hospitals, two facts of importance have been rather universally recognized. The first fact refers to the general prevalence of the streptococcus (normally one of the hemolytic varieties) in pneumonia following measles. The second fact refers to the prevalence of the streptococcus, likewise one of the hemolytic varieties, as an organism associated in many localities with the pneumococcus in the production of epidemic pneumonia not preceded by measles or influenza, but as a distinct type in which the pneumococcus has appeared to play but a minor role. In certain localities, during the recent epidemic of influenzal pneumonia, the pneumococcus was the prevalent type of infection both in the acute disease and in the subsequent empyemas. In other localities the pneumococcus and streptococcus have been associated, while in others streptococcus pneumonias have been more frequently encountered than had been heretofore generally recognized.

In the series of empyema here reported only those are included which required treatment by aspiration or operation. There were available for this report 35 empyema patients who recovered by repeated aspirations alone, while 275 came to operation. Those patients were not included who died within a few days of admission with an established diagnosis of empyema or those who died during the course of aspirations designed for their relief, but who, because of activity of the pneumonic process, acute bilateral empyema, purulent pericarditis, meningitis or other serious complications, were not considered reasonable operative risks.

Because of the interest attached to variations of treatment, with increasing experience, these empyema patients have been grouped, depending largely upon three-time intervals, as follows:

1. First series: Early operation (October 20, 1917, to January 21, 1918), 85 cases. Mortality, 61.2 per cent.
2. Second series: Early aspirations and late operation (January 12, 1918, to August 10, 1918), 96 cases. Mortality, 15.6 per cent.
3. Third series: Early aspirations and late operation (October 18, 1918, to February 14, 1919), 94 cases. Mortality, 9.5 per cent.

The three series of operated empyemas are comparable as to number. Each series represents as accurately as possible, but with some overlapping, different types of preceding pneumonia. The series are also comparable as to type of infection.

FIRST SERIES, EARLY OPERATION. This series of 85 patients occurred during the measles epidemic which affected the 89th and 92d Divisions of the Army, stationed at Camp Funston. The epidemic began about October 18, 1917, and reached its crest during the week ending December 28, 1917, gradually declining to February 15, 1918, after which to May 18 the disease existed in sporadic form with each new influx of recruits. During this period about 3000

patients with measles were admitted to the base hospital. During October but 1 empyema operation was performed; during November, 24; during December, 42; from January 1 to January 21, 1918, 18. These patients were operated upon as soon as the diagnosis of empyema was made and are therefore described under the heading of early operation. The following tables bring out the important facts relative to the mortality:

TABLE I.—SERIES I, EARLY EMPYEMA OPERATIONS, OCTOBER 20, 1917, TO JANUARY 21, 1918.

	Total operations.	Deaths.	Mortality, per cent.
October, 1917	1	1	100.0
November	24	15	62.5
December	42	27	64.3
January, 1918	18	9	50.0
Total	85	52	61.2

TABLE II.—TYPE OF OPERATION.

	Number.	Deaths.	Mortality, per cent.
Costectomy	50	28	56.0
Thoracotomy	32	21	65.6
Unrecorded	3	3	—
	85	52	—
Costectomy, right	32	14	43.7
Thoracotomy, right	18	12	66.6
Costectomy, left	18	14	77.7
Thoracotomy, left	14	9	64.3
	82	49	—
Unrecorded	3	3	—
	85	52	61.2

TABLE III.—ANESTHESIA.

	Number.	Deaths.	Mortality, per cent.
Local	71	43	60.5
General	11	6	54.5

TABLE IV.—TYPE OF PNEUMONIA PRECEDING EMPYEMA.

	Number.	Deaths.	Mortality, per cent.
Lobar pneumonia	46	25	54.3
Measles pneumonia ¹	39	27	69.2
Total	85	52	61.2

¹ The term measles pneumonia includes lobar and bronchopneumonia following measles. It was difficult clinically to distinguish the type in many patients. In a series of 46 necropsies upon measles-pneumonia patients, lobar pneumonia was found in 41 per cent. and bronchopneumonia in 54 per cent.

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TABLE V.—TYPE OF INFECTION IN EMPYEMA FLUIDS.

	Strept. hem.	Strept. non-hem.	Pneumo.	No record or growth.
Lobar pneumonia empyema, recovered .	6	4	8	3
Lobar pneumonia empyema, death .	7	7	7	4
	<hr/> 13	<hr/> 11	<hr/> 15	<hr/> 7
Measles pneumonia empyema, recovered	3	6	1	2
Measles pneumonia empyema, deaths .	9	10	3	5
	<hr/> 12	<hr/> 16	<hr/> 4	<hr/> 7

TABLE VI.—PER CENT. RECOVERIES AND DEATHS AS TO TYPES OF PNEUMONIA AND INFECTION.

	Number.	Strept., per cent.	Pneumo., per cent.
Lobar pneumonia empyema, recovered .	18	25.6	20.5
Lobar pneumonia empyema, death .	21	35.9	17.9
	<hr/> 39	<hr/> 61.5	<hr/> 38.4
Measles pneumonia empyema, recovered	10	28.1	3.1
Measles pneumonia empyema, death .	22	59.3	9.4
	<hr/> 32	<hr/> 87.4	<hr/> 12.5

TABLE VII.—EMPYEMA RECOVERIES AND DEATHS AS TO TYPES OF INFECTION.

	Number.	Recovered, per cent.	Deaths, per cent.
Streptococcus	52	36.5	63.3
Pneumococcus	19	47.4	52.6
	<hr/> 71		

DISCUSSION. The fact was not well recognized at the time of operation upon these patients that pleuritis almost universally accompanied a rapidly spreading pneumonia following measles and that seropurulent or serosanguineous fluid containing streptococci (usually one of the hemolytic varieties) was to be expected in approximately 75 per cent. of those patients who were to succumb whether the chest was drained or not. Costectomy or thoracotomy did not necessarily entail the danger of lung collapse, for in many of them the lung on the affected side was found to be collapsed from pressure of fluid at the time of operation or verification of such condition was obtained at necropsy in the non-operated patients. The danger of an open pneumothorax when associated with an active pneumonic process and diminished alveolar air space was not appreciated at this time. The lungs usually in such cases presented the picture of diffusely scattered areas of peribronchial pneumonia

² Including streptococcus types not differentiated.

(so-called interstitial pneumonia). Operation was done in the hope of affording relief to patients literally drowning in their own septic fluids. That the procedure was not without hope was borne out by the fact that 38.8 per cent. of 85 patients so operated recovered. The high mortality in December, 1917, of 64.3 per cent., soon led to the conclusion that the drainage operation and open pneumothorax carried with it great danger to the patient with an active pneumonic process, and that while the operation carried with it the element of possible benefit to approximately 38 per cent. of the patients, there was great probability that death was hastened in the remaining 62 per cent. It was believed, in other words, that many of these patients were not reasonable operative risks and that many would die irrespective of the treatment employed, since 17, or 33 per cent., died within seventy-two hours from the time the open pneumothorax was secured.

With this end in view the attempt was made, about January 12, 1918, to repeatedly aspirate, in closed circuit by the Potain aspirator, fluids from the chest as soon as diagnosed in active pneumonias. Such aspiration, depending upon the character and amount of fluid was performed every day or alternate day until such time as it was believed the activity of the pneumonic process had subsided. It soon became evident that a considerable number of patients who appeared fatally stricken were relieved by the aspirations. It also was evident among those who died that the end was not hastened, but was in many instances delayed because of the aspirations.

SECOND SERIES (LATE OPERATION). The first operation under this repeated aspiration plan was performed January 29, 1918. Upon this patient a total of nine aspirations had been performed during an interval of seventeen days subsequent to the diagnosis of empyema. Between January 29 and August 10, 1918, 96 patients with empyema were operated, following this plan of procedure. Daily irrigation of the empyema cavity with neutral solution of chlorinated soda was used in these patients. There were 15 deaths, a mortality of 15.6 per cent. Most of the patients in this group developed empyema following lobar pneumonia, but the streptococcus, as in the measles epidemic, continued to be the most frequent infection in the empyema fluids. During the first series of empyema operations the streptococcus was isolated in 52 of 71 operated empyemas, or 73.2 per cent. During the second series the streptococcus was isolated in 70 of 95 operated empyemas, or 73.6 per cent. Many of the patients of this second series developed empyema following streptococcus lobar pneumonia, which occurred in severe epidemic form during March and April, 1918. The mortality by months is shown in Table 8.

TABLE VIII.—SERIES II, LATE EMPYEMA OPERATIONS, JANUARY 29, TO AUGUST 10, 1918.

	Total operations.	Deaths.	Mortality, per cent. ⁶
January, 1918	2	0	0
February	14	2	14.3
March	9	3	33.3
April	44	7	15.9
May	15	2	13.3
June	8	1	12.5
July	3	0	0
August	1	0	0
	<hr/> 96	<hr/> 15	<hr/> 15.6

TABLE IX.—TYPE OF OPERATION.

	Number.	Deaths.	Mortality, per cent.
Costectomy	78	14	17.9
Thoracotomy	18	1	5.5
	<hr/> 96	<hr/> 15	<hr/> 15.6
Costectomy, right	36	5	13.9
Thoracotomy, right	8	1	12.5
Costectomy, left	42	9	21.4
Thoracotomy, left	10	0	0.0
	<hr/> 96	<hr/> 15	<hr/> 15.6

TABLE X.—ANESTHESIA.

	Number.	Deaths.	Mortality, per cent.
Local	68	12	17.6
General	28	3	10.7
	<hr/> 96	<hr/> 15	<hr/> 15.6

TABLE XI.—TYPE OF PNEUMONIA PRECEDING THE EMPYEMA.

	Number.	Deaths.	Mortality, per cent.
Lobar pneumonia	90	14	15.5
Measles pneumonia	6	1	16.6
	<hr/> 96	<hr/> 15	<hr/> 15.6

TABLE XII.—TYPE OF INFECTION IN EMPYEMA FLUIDS.

	Strept., hem. per cent.	Strept., non-hem. per cent.	Pneumo. per cent.	Strept and pneumo. per cent.	No record.
Lobar pneumonia empyema:					
Recovered	33	20	20	2	1
Death	8	3	3	0	0
	<hr/> 41	<hr/> 23	<hr/> 23	<hr/> 2	<hr/> 1
Measles pneumonia empyema:					
Recovered	3	1	1	0	0
Death	1	0	0	0	0
	<hr/> 4	<hr/> 1	<hr/> 1	<hr/> 0	<hr/> 0

TABLE XIII.—PERCENTAGE OF RECOVERIES AND DEATHS AS TO TYPE OF PNEUMONIA AND INFECTION.

	Number.	Strept., hem., per cent.	Strept., non-hem., per cent.	Pneumo., per cent.	Pneumo. and strept. per cent.
Lobar pneumonia empyema:					
Recovered	75	37.1	22.4	22.4	2.2
Death	14	9.0	3.4	3.4	0.0
	<hr/> 89	<hr/> 46.1	<hr/> 25.8	<hr/> 25.8	<hr/> 2.2
Measles pneumonia empyema:					
Recovered	5	50.0	16.6	16.6	0.0
Death	1	16.6	0.0	0.0	0.0
	<hr/> 6	<hr/> 66.6	<hr/> 16.6	<hr/> 16.6	<hr/> 0.0

TABLE XIV.—EMPYEMA RECOVERIES AND DEATHS AS TO TYPES OF INFECTION.

	Number.	Recovered, per cent.	Deaths, per cent.
Streptococcus	69	82.6 ₃	17.4 ⁴
Pneumococcus	24	87.5	12.5
Mixed infection (streptococcus and pneumococcus)	2	100.0	
	<hr/> 95		

Table 15 shows the average number of aspirations performed and the average number of days before operation in the 96 patients with empyema constituting the second series.

TABLE XV.—NUMBER OF ASPIRATIONS AND DAYS BEFORE OPERATION.

	Number.	Average number of aspirations before operation.	Average num- ber of days before opera- tion.
Recovery	81	6 ⁵	19 ⁶
Death	15 ⁷	6	21

SERIES III (LATE EMPYEMA OPERATIONS). The third series of empyema followed pneumonia incident to the epidemic of influenza during the autumn of 1918. Between October 18, 1918, and Feb-

³ Among the recoveries, three patients had post-scarlet fever pneumonia, empyema (*Streptococcus hemolyticus*) and nephritis. Two patients subsequent to lobar pneumonia and the healing of their empyemas were found to have active pulmonary tuberculosis. One patient had lobar pneumonia with empyema which was operated, followed by pneumonia on the opposite side with pleural effusion which was relieved by aspiration and eventual recovery.

⁴ Four deaths occurred from nephritis in post-scarlet fever pneumonia and empyema. One death occurred from streptococcus endocarditis and nephritis following post-scarlet fever lobar pneumonia and empyema.

⁵ Not including one patient who had bilateral empyema with four distinct pockets; a total of 68 aspirations were performed before costectomy, followed by recovery.

⁶ Not including two patients from whom operation was delayed for an unusually long period because of their critical condition due to nephritis. Both recovered.

⁷ Four of the fifteen deaths resulted from post-scarlet fever nephritis. One death resulted from post-scarlet fever endocarditis and nephritis.

ruary 14, 1919, 94 patients required operation. Of these 9 have died to April 8, 1919; 73 have recovered; 10 are still in hospital, with prognosis favorable; while 2 patients have an unfavorable prognosis, due to tuberculosis with large pyopneumothorax in each.

TABLE XVI.—TYPE OF OPERATION.

	Number.	Deaths.	Mortality, per cent. ⁸
Costectomy	88	7	7.9
Thoracotomy	6	2	33.3
	<hr/> 94	<hr/> 9	<hr/> 9.5

TABLE XVII.—ANESTHESIA.

	Number.	Deaths.	Mortality, per cent. ⁹
Local	91	9	9.8
General	3	0	0.0
	<hr/> 94	<hr/> 9	<hr/> 9.5

TABLE XVIII.—TYPE OF PNEUMONIA PRECEDING THE EMPYEMA.

	Number.	Deaths.	Mortality, per cent. ¹⁰
Influenzal pneumonia ¹¹	41	2	4.9
Lobar pneumonia	30	5	16.6
Measles pneumonia	17	1	5.9
Bronchopneumonia	6	1	16.6
	<hr/> 94	<hr/> 9	<hr/> 9.5

TABLE XIX.—TYPE OF INFECTION IN EMPYEMA FLUIDS.

	Number.	Per cent.
Streptococcus hemolyticus	53	62.3
Streptococcus, non-hemolytic	6	7.0
Pneumococcus	25	29.4
Streptococcus viridans and pneumococcus	1	1.1
	<hr/> 85	
No record or contamination	9	
	<hr/> 94	

TABLE XX.—EMPYEMA RECOVERIES AND DEATHS AS TO TYPE OF INFECTION.

	Number.	Recovered, per cent.	Deaths, per cent. ¹²
Streptococcus	59	93.3	6.7
Pneumococcus	25	84.0	16.0
Mixed infection (streptococcus and pneumococcus)	1	100.0	

⁸ To April 8, 1919.⁹ To April 8, 1919.¹⁰ To April 8, 1919.¹¹ During the epidemic of influenza, the pneumonia was of lobar type in 72.6 per cent. of 55 patients upon whom necropsy was performed.¹² To April 8, 1919.

Table 21 shows the average number of aspirations performed and the average number of days before operation in the ninety-four empyema patients of the third series.

TABLE XXI.—NUMBER OF ASPIRATIONS AND DAYS BEFORE OPERATION.

Number.	Average number of aspirations before operation.	Average number of days before operation.
94	3.7	13.5

DISCUSSION OF TYPES OF INFECTION IN THE THREE SERIES. In Table 22 the percentage of cultures positive for streptococcus and pneumococcus in the three series of operations have been arranged for purposes of comparison. It will be observed in each series that the streptococcus (usually one of the hemolytic varieties) has been the type of infection responsible for the condition in approximately 70 per cent. of the patients.

TABLE XXII.—COMPARISON OF TYPES OF INFECTION IN THREE SERIES OF EMPYEMA.

	Number.	Strept., per cent.	Pneumo., per cent.
First series	71	73.2	26.7
Second series	95	73.6	26.3
Third series	85	70.4	29.4

For purpose of comparison as influenced by the radically different treatment in the first as compared with the second and third series the following table is given. It will be observed that in the first series, when early operation was done, the percentage of recoveries in streptococcus empyema was 36.5, while in the second and third series, when late operation was done, the percentage of recoveries in streptococcus empyema was 82.6 and 93.3 respectively. In the first series the percentage of recoveries in pneumococcus empyema was 47.4, while in the second and third series the percentage of recoveries in pneumococcus empyemas was 87.5 and 84 respectively.

TABLE XXIII.—COMPARATIVE RECOVERIES AS TO TYPE OF INFECTION IN THREE SERIES OF EMPYEMA.

	Number.	Strept. recoveries, per cent.	Pneumo. recoveries., per cent.
First series	71	36.5	47.4
Second series	95	82.6	87.5
Third series	85	93.3	84.0

NECROPSY FINDINGS. Necropsies were performed upon forty-eight patients who died subsequent to empyema operations. Abstracts of the clinical diagnoses and the necropsy findings have been arranged in sequence for the three series of operations.

FIRST SERIES EMPYEMA, NECROPSY ABSTRACTS.¹³

No. 9, 1917. Clinical Diagnosis: Pneumonia, lobar left; empyema, operated left.

Anatomical Diagnosis: Pneumonia, lobar left lower; empyema, left; pleurisy, fibrinous right.

No. 11, 1917. Clinical Diagnosis: Pneumonia, lobar right lower; empyema, operated right.

Anatomical Diagnosis: Pneumonia, lobar right with abscess formation; empyema, right; pericarditis, purulent acute; endocarditis (mitral and aortic), acute.

No. 24, 1917. Clinical Diagnosis: Measles; pneumonia, bronchobilateral; empyema, operated right.

Anatomical Diagnosis: Pneumonia, lobar with cavity formation right; empyema, right; pleuritis, fibrinopurulent right.

No. 26, 1917. Clinical Diagnosis: Measles; pneumonia, broncho, right; empyema, operated right.

Anatomical Diagnosis: Empyema, right; peritonitis, plastic with adhesions between diaphragm and liver.

No. 27, 1917. Clinical Diagnosis: Pneumonia, postoperative broncho, right, following appendectomy; empyema operated right.

Anatomical Diagnosis: Bronchopneumonia; empyema, right; peritonitis purulent diffuse; nephritis, parenchymatous acute; fatty degeneration of liver; ulcerative endocarditis.

No. 31, 1917. Clinical Diagnosis: Measles; bronchopneumonia; bilateral; empyema, operated right.

Anatomical Diagnosis: Pneumonia, lobar right; infarcts, hemorrhagic left lung; empyema, localized right; endocarditis, ulcerative pulmonary valves; embolism and thrombosis of mesenteric vessels with diffuse hemorrhage into mesentery and omentum.

No. 36, 1917. Clinical Diagnosis: Measles; pneumonia, lower left and lower right; empyema, operated right.

Anatomical Diagnosis: Pneumonia, lobar left; empyema, right; endocarditis, vegetative mitral and aortic valves; nephritis, diffuse subacute.

No. 37, 1917. Clinical Diagnosis: Measles; bronchopneumonia, bilateral; empyema, operated right.

Anatomical Diagnosis: Pleuritis, fibrinous right; retraction and edema of right lung; nephritis, parenchymatous subacute; fatty degeneration of liver.

No. 4, 1918. Clinical Diagnosis: Measles; pneumonia, lobar right; empyema, operated left.

Anatomical Diagnosis: Pneumonia, lobar of upper and middle lobes right; empyema, bilateral.

¹³ In these necropsy abstracts the sequence of clinical diagnoses preceding the empyema is given. This sequence may not correspond with the findings at necropsy because of the long interval in some instances between operation and death.

No. 6, 1918. Clinical Diagnosis: Measles; pneumonia, lobar left; empyema, operated left.

Anatomical Diagnosis: Empyema, bilateral; pericarditis, purulent acute; nephritis, parenchymatous acute.

No. 8, 1918. Clinical Diagnosis: Pneumonia, broncho, bilateral; empyema, operated right with probable extension to left.

Anatomical Diagnosis: Pneumonia, lobar right and lower lobe left; empyema, right; pericarditis, acute (early).

No. 9, 1918. Clinical Diagnosis: Measles; pneumonia, broncho, bilateral; empyema, operated left.

Anatomical Diagnosis: Empyema, left; pericarditis, purulent acute (200 c.c.); peritonitis, diffuse acute.

No. 10, 1918. Clinical Diagnosis: Measles; pneumonia, lobar right; empyema, operated right.

Anatomical Diagnosis: Pneumonia, lobar lower left; empyema, right; tuberculosis, fibroid, right lung with calcified and cheesy peribronchial glands.

No. 12, 1918. Clinical Diagnosis: Pneumonia, broncho, left; empyema, operated left.

Anatomical Diagnosis: Pneumonia, broncho, left (extensive), less marked in right lung; large abscess in lower lobe of left lung; empyema, left, well drained; edema of both lungs.

No. 13, 1918. Clinical Diagnosis: Pneumonia, lobar, left; empyema operated, left; empyema, right; erysipelas, facial; nephritis, acute.

Anatomical Diagnosis: Bronchopneumonia, right, with abscess of lower lobe; localized dry empyema, right; pleural thickening and adhesions following rib resection, left; nephritis, acute; septic spleen; hyperemia and edema of brain.

No. 14, 1918. Clinical Diagnosis: Measles; bronchopneumonia; empyema, operated right; probable pericarditis.

Anatomical Diagnosis: Pneumonia, broncho, bilateral; empyema bilateral; substernal pus pocket, left; pericarditis, purulent acute (1000 c.c.); peritonitis, acute (early).

No. 17, 1918. Clinical Diagnosis: Pneumonia, lobar, right; empyema, operated right.

Anatomical Diagnosis: Peritonitis, purulent, diffuse; empyema, right.

No. 18, 1918. Clinical Diagnosis: Pneumonia, lobar lower left and right; empyema, operated right.

Anatomical Diagnosis: Carnification of right lung with interstitial changes; thickening of right pleura; nephritis, parenchymatous acute.

No. 20, 1918. Clinical Diagnosis: Measles; pneumonia, lobar (early), right; empyema, operated left.

Anatomical Diagnosis: Pneumonia, lobar, lower right (early); empyema, left with retraction of lung; thickened pleura and pleural

pus pockets; pericarditis, purulent acute; nephritis, parenchymatous acute.

No. 24, 1918. Clinical Diagnosis: Pneumonia, lobar, lower left; empyema, operated left; arthritis, acute.

Anatomical Diagnosis: Pneumonia, lobar, lower left, and entire right lung; empyema, bilateral, with drainage of left; substernal pus pocket, right; parenchymatous degeneration, acute, of kidneys.

No. 25, 1918. Clinical Diagnosis: Measles, pneumonia, lobar right; empyema, operated right; probable pericarditis.

Anatomical Diagnosis: Pneumonia, unresolved, right lung with abscess in upper lobe; empyema, right; substernal pus pocket, right; parenchymatous degeneration, acute, of liver and kidneys.

No. 26, 1918. Clinical Diagnosis: Pneumonia, lobar, left and right lower; empyema, operated left; peritonitis.

Anatomical Diagnosis: Pneumonia, lobar, left; compensatory emphysema of right lung; empyema, left; pleuritis, fibrinopurulent, lining entire anterior and lateral surfaces of left chest and lung; septic spleen.

No. 33, 1918. Clinical Diagnosis: Measles; pneumonia, broncho, right; empyema, operated, right; toxic myocarditis.

Anatomical Diagnosis: Retraction and carnification of right lung; empyema, right; substernal pus pocket, right; peritonitis, acute, diffuse with perihepatitis and perisplenitis.

No. 39, 1918. Clinical Diagnosis: Pneumonia, lobar, left; empyema, bilateral (operated right); peritonitis.

Anatomical Diagnosis: Pneumonia, lobar, left; empyema, bilateral; walled-off pus pockets, left, anterolateral chest wall between upper and middle lobes of right lung and between pericardium and sternum on right; peritonitis, acute, diffuse; parenchymatous degeneration, acute, of kidneys, liver and spleen.

No. 44a, 1918. Clinical Diagnosis: Pneumonia, right and left; empyema, operated, left; probable peritonitis, mitral regurgitation.

Anatomical Diagnosis: Empyema, left; substernal pus pocket; retraction of left lung; pleural effusion (400 c.c.), right, with edema of lung; pericarditis, purulent chronic, with erosion of heart muscle and fibrous thickening of tissue in region of auriculoventricular bundle; ascites (700 c.c.).

No. 57, 1918. Clinical Diagnosis: Measles; bronchopneumonia, right; empyema, operated, right; intrapleural hemorrhage; probable necrosis and gangrene of right lung.

Anatomical Diagnosis: Empyema, right; collapse of right lung with necrotic areas and intrapleural hemorrhage.

No. 61, 1918. Clinical Diagnosis: Measles; pneumonia, lobar, right; empyema, operated right; bronchopleural communication right.

Anatomical Diagnosis: Empyema, healed right; tuberculous nodules in lungs, spleen, liver, kidneys, pleura and peritoneal surface of diaphragm; nephritis, parenchymatous acute; edema of brain.

SECOND SERIES EMPYEMA, NECROPSY ABSTRACTS.

No. 67, 1918. Clinical Diagnosis: Pneumonia, lobar, right lower and entire left; empyema, bilateral (operated left); nephritis, acute.

Anatomical Diagnosis: Empyema, left; peritonitis, acute diffuse; nephritis, parenchymatous acute.

No. 72, 1918. Clinical Diagnosis: Pneumonia, broncho, bilateral; empyema, bilateral (operated right); probable phlebitis left saphenous vein; pleuropericarditis; probable peritonitis and substernal pus pocket (right); septic arthritis, left hip and left elbow.

Anatomical Diagnosis: Empyema, bilateral; thrombosis of saphenous vein (left); pyemia with involvement of left elbow and abscess below left clavicle; substernal pus pocket, right.

No. 118, 1918. Clinical Diagnosis: Pneumonia, lobar, left, followed by empyema, operated, left; substernal pus pocket, right; pneumonia, broncho, right; peritonitis; possible pericarditis, purulent acute; nephritis parenchymatous acute.

Anatomical Diagnosis: Atelectasis and edema of left lung; walled-off empyema, left; early pneumonia of lower lobe, right; peritonitis, suppurative acute; nephritis, subacute, in slightly contracted kidneys; sacral decubitus; fatty degeneration of myocardium and liver; hyperplasia of spleen.

No. 130, 1918. Clinical Diagnosis: Empyema, operated, left; pyopneumothorax, right; pericarditis, plastic acute.

Anatomical Diagnosis: Empyema, left; substernal pus pockets, bilateral (100 c.c. pus in each); empyema, right (600 c.c.); pneumonic consolidation of upper lobe of right lung with multiple abscesses; atelectasis of lower lobe, right; pericarditis, fibrinopurulent early acute; marked parenchymatous nephritis and myocarditis.

No. 139, 1918. Clinical Diagnosis: Pneumonia, lobar, right; empyema, operated, right; pericarditis, plastic acute; pleuritis, plastic left.

Anatomical Diagnosis: Empyema, right; pleuritis obliterative, right; pleuritis fibrinous, left; pericarditis, serofibrinous acute (shaggy heart); degeneration, fatty, of myocardium.

No. 161, 1918. Clinical Diagnosis: Pneumonia, lobar, resolved, right; empyema, operated, right; pericarditis, purulent; peritonitis, purulent, diffuse; nephritis, parenchymatous; probable subdiaphragmatic abscess; toxic myocarditis.

Anatomical Diagnosis: Empyema, right, walled-off, free from pus; empyema, left (500 c.c.); atelectasis of left lung; peritonitis,

fibrinopurulent, acute diffuse; acute toxic splenitis and nephritis (large white kidney); hydropericardium (200 c.c.).

No. 167, 1918. Clinical Diagnosis: Measles; pneumonia, broncho, left; empyema, operated, left; empyema, right; pneumonic infiltration of lower lobe of right lung; possible pericarditis and peritonitis.

Anatomical Diagnosis: Empyema, operated, left; empyema, right, 300 c.c. in three large pockets; peritonitis, fibrinopurulent, diffuse; atelectasis, partial, both lungs; hyperplasia with multiple infarcts of spleen; marked toxic nephritis and myocarditis.

No. 180, 1918. Clinical Diagnosis: Pneumonia, lobar, left; empyema, operated, left; peritonitis.

Anatomical Diagnosis: Empyema, left empty and nearly healed; complete atelectasis of left lung; obliterative pleuritis, left; peritonitis, suppurative, diffuse acute; pleuritis, fibrinopurulent, early acute, right; hypostatic congestion and edema of lungs; nephritis, parenchymatous acute; hyperplasia of spleen; degeneration, fatty of liver; cloudy swelling and fatty degeneration of myocardium.

No. 187, 1918. Clinical Diagnosis: Tonsillitis, follicular, acute; pleurisy, fibrinous, acute, right; empyema, operated, right; parenchymatous nephritis.

Anatomical Diagnosis: Empyema, right; pleuritis, fibrous, obliterative, right; atelectasis of middle and lower lobes of right lung; nephritis, parenchymatous chronic (large red kidneys); hypertrophy and dilatation of heart with marked fatty degeneration of myocardium.

No. 193, 1918. Clinical Diagnosis: Scarlet fever; pneumonia, lobar, left; pyopneumothorax, operated, left; pneumonia, lobar, right; nephritis, parenchymatous chronic; toxic myocarditis.

Anatomical Diagnosis: Empyema, left, drained empty; pleuritis, fibrous, chronic left and right; atelectasis, complete, left lung; nephritis, parenchymatous chronic with acute exacerbation; multiple minute petechial hemorrhages of all serous surfaces; edema of mesentery and retroperitoneal tissues; degeneration, fatty, marked, of myocardium; fibrous perisplenitis and localized peritonitis; congestion, chronic, passive, of liver.

No. 194, 1918. Clinical Diagnosis: Pneumonia, lobar, left; empyema, operated, left; nephritis, parenchymatous; myocarditis, toxic.

Anatomical Diagnosis: Pneumonia, unresolved, of entire left lung with abscess formation; empyema, left, empty; pleuritis, fibrous, left; nephritis, parenchymatous chronic, with acute exacerbation; degeneration, fatty, with toxic softening of myocardium; degeneration, fatty, with passive congestion of liver; hyperplasia, chronic, with passive congestion and pericapsular fibrosis of spleen; edema of retroperitoneal tissues.

No. 195, 1918. Clinical Diagnosis: Scarlet fever; pneumonia,

lobar, right; empyema, operated, right; myocarditis, toxic; nephritis, parenchymatous, chronic.

Anatomical Diagnosis: Healing, empyema, right; pleuritis, fibrous, right; atelectasis and atrophy of right lung; nephritis, parenchymatous, chronic; marked toxic softening and fatty degeneration of myocardium with hypertrophy and dilatation; chronic hyperplasia of spleen; degeneration, fatty, of liver; cholelithiasis

No. 200, 1918. Clinical Diagnosis: Pneumonia, lobar, left; nephritis, parenchymatous (scarlet fever); empyema, operated, left; valvular heart disease (mitral regurgitation).

Anatomical Diagnosis: Tuberculosis, fibrocaseous miliary, of left lung; pleuritis, obliterative fibrous and tuberculous left; empyema, left, empty; pleuritis, serous, right (300 c.c.); nephritis, parenchymatous, chronic; degeneration, fatty, with toxic softening and dilatation of heart; edema and passive congestion of omentum, mesentery and retroperitoneal tissue with hemorrhage into small bowel and into stomach (slight).

No. 218, 1918. Clinical Diagnosis: Pneumonia, lobar, right lower; empyema, operated right; nephritis parenchymatous, acute.¹⁴

Anatomical Diagnosis: Atelectasis complete, right lung; edema of left lung; old fibrous pleurisy over external surface of right lung; subcutaneous ecchymoses over right side of body; subserous ecchymoses of pericardium, left pleura and peritoneum; serohemorrhagic effusions in the pericardial and left pleural cavities (700 c.c.).

THIRD SERIES EMPYEMA, NECROPSY ABSTRACTS.

No. 279, 1918. Clinical Diagnosis: Pneumonia, lobar, left; empyema, operated, left; probable pericarditis, purulent acute.

Anatomical Diagnosis: Pneumonia, lobar, left, with collapse of lung; empyema, drainage, left; pericarditis, seropurulent acute (1000 c.c.); emphysema of cellular tissue in anterior mediastinum; nephritis, parenchymatous acute, on chronic, left; nephritis, parenchymatous acute, right.

Bacteriological Findings: Left lung (blood-agar), pneumococci; heart's blood (broth), pneumococci; pericardial fluid (broth), pneumococci; pus from kidney, pneumococci.

No. 282, 1918. Clinical Diagnosis: Pneumonia, lobar, bilateral; empyema, bilateral (operated left).

Anatomical Diagnosis: Pneumonia, lobar, left and lower lobe of right lung; pneumonia, broncho, upper and middle lobes of right lung; empyema, left, with collapse of lung and pleuritis, fibrino-

¹⁴ This patient died with clinical manifestations of uremia due to almost complete suppression of urine for three days before death. No mention was made of nephritis in the anatomic diagnosis but the kidneys were described in the necropsy report as follows: "The kidneys are not enlarged, the capsule comes away leaving a smooth surface which is pale and has a somewhat yellowish cast on section. The cortex is not enlarged and has homogeneous pinkish yellow color. Malpighian bodies are not well seen."

purulent acute; nephritis, parenchymatous acute; peritonitis adhesive, chronic; venous congestion, fatty degeneration and cloudy swelling of liver.

Bacteriological Findings: Pleural fluid, *Streptococcus hemolyticus*; pericardial fluid, *Streptococcus hemolyticus*.

No. 284, 1918. Clinical Diagnosis: Pneumonia, lobar, lower, left; empyema operated, left.

Anatomical Diagnosis: Empyema, left, with adhesive pleuritis, diaphragmatic bilateral; edema of lungs, bilateral; bronchitis and bronchiolitis purulent, left; cloudy swelling of liver and kidneys; nephritis, parenchymatous chronic, slight, of right kidney.

Bacteriological Findings: Lung (broth), pneumococcus; pleural fluid, pneumococcus and *Streptococcus hemolyticus*.

No. 294, 1918. Clinical Diagnosis: Influenza; pneumonia, lobar, bilateral; empyema, operated, left; empyema, right; pericarditis, fibrinous, acute.

Anatomical Diagnosis: Pneumonia, lobar, of entire right lung, lower lobe of left lung, lower margin of upper lobe of left lung; empyema, drainage, left; pleuritis fibrinoplastic and purulent bilateral; pericarditis fibrinoplastic and purulent; nephritis, parenchymatous, acute.

Bacteriological Findings: Pericardial fluid (blood-agar), pneumococcus; pericardial fluid (broth), pneumococcus; lung (blood-agar), pneumococcus; pleural exudate (broth), pneumococcus; pleural exudate (blood-agar), pneumococcus; heart's blood (broth), pneumococcus; heart's blood (blood-agar), pneumococcus.

No. 297, 1918. Clinical Diagnosis: Influenza; measles; broncho-pneumonia; empyema, operated, left; nephritis, parenchymatous, acute.

Anatomical Diagnosis: Pneumonia, lobar, of lower left and middle and lower right; pneumonia, broncho, of upper left and upper right; purulent bronchitis; empyema, left; nephritis, parenchymatous, acute; cloudy swelling and fatty changes in liver; septic spleen.

Bacteriological Findings: Heart's blood, pneumococcus; lung, pneumococcus.

No. 298, 1918. Clinical Diagnosis: Pneumonia, lobar, lower left and middle and upper right; empyema, operated, left.

Anatomical Diagnosis: Pneumonia, broncho, lower right; pneumonia, lobar, upper right and entire left lung; empyema, left; pericarditis, fibrinopurulent, acute (500 c.c.); nephritis, parenchymatous, chronic.

Bacteriological Findings: Heart's blood, pneumococcus; lung, pneumococcus.

No. 12, 1919. Clinical Diagnosis: Influenza; pneumonia, broncho; empyema, operated, left; meningitis, acute (*Streptococcus hemolyticus*).

Anatomical Diagnosis: Empyema, left, practically healed; pleuritis obliterative, left; meningitis, basilar, fibrinoplastic and purulent; leptomeningitis of entire surface of cerebrum; empyema of all ventricles of brain.

Bacteriological Findings: Meningeal exudate, lateral ventricles, Streptococcus hemolyticus; spinal fluid cultures, Streptococcus hemolyticus.

COMPLICATIONS SUBSEQUENT TO OPERATION.

The complications subsequent to operation as disclosed at necropsy in these forty-eight patients are given in Table 24.

TABLE XXIV.

	First series, necropsies, 27. Per cent.	Second series, necropsies, 14. Per cent.	Third series, necropsies, 7. Per cent.
Nephritis	40.7	85.7	85.7
Pericarditis	29.6	21.4	57.1
Peritonitis	25.9	42.8	14.2
Substernal pus pockets	18.5	14.3	0.0
Lung abscess	18.5	14.3	0.0
Empyema bilateral	22.2	28.6	14.2
Endocarditis	14.8	0.0	0.0
Meningitis (metastatic)	0.0	0.0	14.2
Pneumonia of both sides	25.9	28.5	57.1

In Table 25 is given the findings in 100 patients, with empyema, who came to necropsy without operation between November, 1917, and January 25, 1919. Many of these patients died while the pneumonic process was active and were not considered suitable risks for any kind of operation except aspiration.

TABLE XXV.—NECROPSY FINDINGS IN ONE HUNDRED EMPYEMA PATIENTS UPON WHOM OPERATION WAS NOT PERFORMED.

	Per cent.
Nephritis, parenchymatous acute diffuse or exacerbation of chronic	47
Pericarditis, serofibrinous or purulent	46
Pneumonia active in both lungs	45
Empyema, bilateral	19
Abscess of lung	15
Peritonitis, metastatic diffuse purulent	13
Substernal pus pockets	11
Endocarditis, ulcerative or vegetative acute	3
Tuberculosis, pulmonary active	3
Meningitis, subacute basilar	3

Nephritis. In 85.7 per cent. of 21 patients who died subsequent to the operations of the second and third series, nephritis was found at necropsy. In a considerable number of these patients scarlet fever had immediately preceded the pneumonia and empyema. The nephritis was usually of the acute parenchymatous or diffuse

form. In a few an acute exacerbation of a chronic diffuse nephritis had occurred. Pneumonia with empyema following scarlet fever carried with it a much more serious prognosis than pneumonia and empyema without this immediately preceding acute disease. The urinary output and analysis should be carefully watched in every empyema patient. The acute sepsis has not produced either in the 48 necropsies upon patients who had been operated for empyema or in the 100 necropsies upon patients who died without operation the picture of amyloid kidney in any case. Bilateral empyema was present in 30 per cent. of 23 instances of nephritis in the operated patients of the first and second series.

Pericarditis. Pericarditis, seropurulent or purulent, occurred in 36 per cent. of 48 patients who came to necropsy subsequent to empyema operations. It occurred in 46 per cent. of 100 patients with non-operated empyema who came to necropsy. In many patients the occurrence of a to-and-fro pericardial friction rub could be detected prior to the widened area of heart dulness and the more distant heart tones due to effusion. Such an occurrence was of serious prognostic significance in a patient with empyema (Fig. 1).

The diagnosis of purulent pericarditis is attended with great difficulty. I have repeatedly seen at necropsy the normal amount of pericardial fluid replaced with thin fibrinopurulent fluid, or, if the process had existed for twelve to fourteen days, as judged by the clinical history, fibrin organization had taken place, with firm enveloping adhesions, between the pericardium and myocardium and the typical picture of the so-called "shaggy heart." In many such patients the area of heart dulness was not increased either by percussion or the roentgenogram, since distention of the pericardium had not taken place. There had merely been a change from a serous to a fibrinopurulent fluid in the pericardium. Any earlier friction rub which may have been transitory was with difficulty differentiated from a pleuropericardial rub in a patient with rapid respirations, due to pneumonia, an empyema or a pneumothorax. The distant heart tones present in hydropericardium could not be relied upon in the diagnosis of those instances of purulent pericarditis in which the fluid was not greatly increased in amount. A left-sided closed pneumothorax also so muffled the heart tones in numerous instances as to lead to a suspicion of pericarditis, with effusion, when such a condition did not exist.

Paracentesis of the pericardium for the relief of effusion, if carefully performed, involves little risk. It should be mentioned, however, that in only one patient was the procedure of any avail in contributing to recovery. In diagnostic and prognostic importance the procedure was of value.

In the 27 necropsies which followed the first series of empyema operations, 4 instances of pericarditis followed an empyema of the

left side, 3 followed empyema of the right side, while in 1 the empyema was bilateral.

In the 14 necropsies which followed the second series of empyema operations, 1 instance of pericarditis followed empyema of the right side while in 2 instances the empyema was bilateral.

In the 7 necropsies which followed the third series of empyema operations, 3 instances followed empyema of the left side while in 1 instance the empyema was bilateral. To recapitulate, in 15 patients, pericarditis, usually purulent, developed in 7 instances when the empyema was on the left side, in 4 instances when the empyema was on the right side and in 4 instances when the empyema was bilateral. The occurrence of pericarditis bears an undoubted relationship to the presence of substernal pus pockets (*vide infra*).

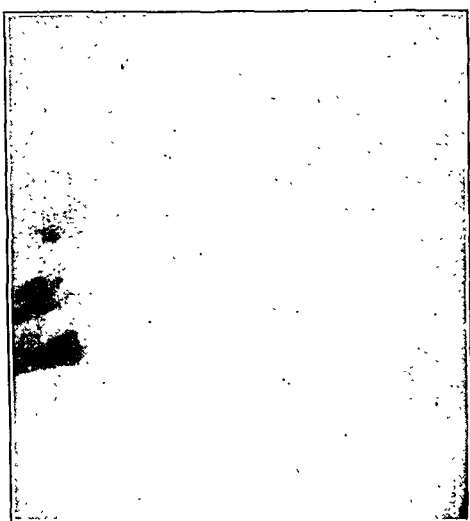


FIG. 1.—Encapsulated empyema, left, with pericardial effusion. Oper. Series II, No. 3. Recovery.



FIG. 2.—Abscess of lung, right, with bronchial drainage. Probable tuberculosis, left. Recovery.

Substernal Pus Pockets. The occurrence of this serious complication apparently varied with the type of pneumonia. It was more commonly noted subsequent to the type of interstitial pneumonia which followed measles and the empyemas constituting the first series of operations (18.5 per cent. of 27 necropsies). It also was encountered in 14.3 per cent. of the instances of empyema necropsies of the second series, which likewise occurred subsequent to an epidemic of streptococcus pneumonia, in which many interstitial types of pneumonia were encountered. In the third series of empyema necropsies (following influenzal pneumonia) this complication was not encountered and but few instances of the interstitial types of pneumonia occurred. Substernal pus pockets appeared to be an infrequent complication except in the interstitial types of

streptococcus pneumonia. We¹⁵ have believed that the spread of the infection to this locality occurred by way of the lymphatic channels of the parietal pleura to the chain of substernal lymph nodes immediately beneath the sternum and which were not directly connected with the anterior mediastinum. The situation of these pus pockets apparently made infection of the pericardium more liable to occur by contiguity.

Peritonitis. Peritonitis, serofibrinous or purulent diffuse, occurred in 14 of the 48 necropsies (29.2 per cent.), constituting the patients with operated empyema in the three series; in 5 the empyema was bilateral, in 5 the empyema occurred on the left side, while in 4 the empyema occurred on the right side. Extension had occurred through the diaphragm in all but 1 of the cases. In 1 patient a postoperative pneumonia and empyema followed appendectomy, with peritonitis. In but 1 instance did verified peritonitis occur without empyema.

Bilateral Empyema. Bilateral empyema was found in 11, or 22.9 per cent., of 48 patients who came to necropsy in the three series of empyema operations. In the majority of patients in which this occurred there had been pneumonia affecting both lungs.

Bilateral Pneumonia. Bilateral pneumonia was found in 15, or 31.2 per cent., of 48 patients who came to necropsy in the three series of empyema operations. In a considerable additional number of cases the lung on the opposite side was collapsed or markedly edematous. In others an obliterative fibrous pleuritis was present on the side opposite to the operated empyema. This had occurred as a sequel to fibrinous pleuritis accompanying the earlier bilateral pneumonia.

Lung Abscess. Abscess of the lung was found in 7, or 14.6 per cent., of 48 patients upon whom necropsy was performed in the three series of empyema operations. In 5, or 71.4 per cent., of these the abscesses were multiple and occurred on the affected side. Necrosis of lung sufficient to produce considerable intrapleural hemorrhage occurred in one patient (Fig. 2).

Other Complications. Less frequent conditions found at necropsy in the three series of empyema operations were tuberculosis, pulmonary fibrocaseous or miliary; metastatic meningitis; endocarditis; hydropericardium; embolism and thrombosis of mesenteric vessels; myocardial degeneration. The myocardial softening differed in no essential particular from that degree of parenchymatous degeneration affecting all organs in the presence of a chronic septic process. Ascites as a result of myocardial degeneration and nephritis occurred in one instance.

DIAGNOSIS. A pleural effusion or empyema should be suspected in every pneumonia patient whose respiration early in the disease

¹⁵ Stone, W. J., Phillips, B. G., and Bliss, W. P.: Arch. Int. Med., 1918, xxii, 409.

shows embarrassment, especially if associated with a pleural friction rub and pulse-rate out of relative proportion to the fever. The occurrence of severe pleural pain with an expiratory grunt was always suggestive of pleural effusion twenty-four hours later. The aspirating needle should be used early, the points selected being over the areas of greatest dullness. Care should be exercised in the cautious insertion of the needle to avoid pneumothorax from puncture of the lungs (manifested usually by bright blood upon aspiration). The danger of a closed pneumothorax accidentally produced in this manner has probably been overestimated, but its occurrence should, of course, be avoided if possible. The glass syringe should be preferably attached to the needle by a short (two-inch) connection of rubber tubing with fairly heavy wall. In case it was neces-

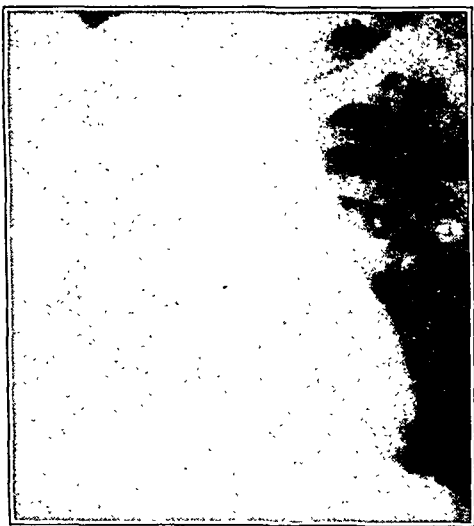


FIG. 3.—Resolving pneumonia on right side, with walled-off fluid in outer portion. Note the high diaphragm. Oper. Series III, No. 55. Recovery.

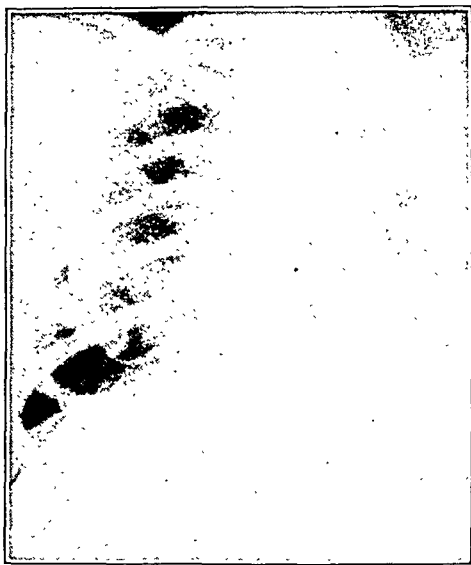


FIG. 4.—Resolving pneumonia, right. Thickened pleura, resolving pneumonia and fluid at base, left.

sary to disconnect the syringe during aspiration, following an exploratory puncture, the rubber tubing was clamped to prevent entrance of air. The physical signs of fluid in many instances were untrustworthy. More distant breath sounds replacing the close-to-the-ear tubular breathing, the abolition of whispered voice transmission, decreased vocal and tactile fremitus and respiratory lagging of the affected side were the essential physical signs. Dulness on percussion was the most important single sign. With quantities of fluid up to 200 c.c., vocal or tactile fremitus and the transmission of whispered voice might still occur if a portion of consolidated lung occupied a position between the fluid and the chest wall. In bilateral empyema, as in acute emphysema, the type of breathing was abdominal rather than costal.

In performing paracentesis it was found wise to remember that the diaphragm may be higher than normal on the affected side, due to pleural adhesions. Roentgenograms of the chest were of great help in localizing small accumulations of fluid, interlobar empyema or pockets of pus in unusual locations, such as near the apex of the lung. The roentgenogram was of little help in the diagnosis of sub-sternal pus pockets. Greater dependence should always be placed upon the history of the clinical course, the physical signs and the aspirating needle. So-called unresolved pneumonia does occasionally occur as a cause of delayed convalescence. When it does occur the cause is usually to be found in a localized empyema. Empyema of the pleural cavity developed very rapidly in certain types of pneumonia in which a hemolytic streptococcus was present as an asso-



FIG. 5.—Walled-off empyema, right, anterolateral portion of chest. Note the high diaphragm.

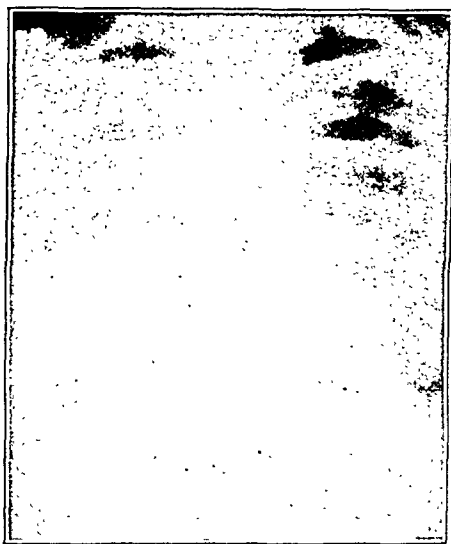


FIG. 6.—Empyema, right, pleural cavity, extending to height of third rib in front. Oper. Series II, No. 38.

ciated infection. This was especially true of the pneumonia following measles, scarlet fever and influenza. The question was very frequently raised in our minds as to the occurrence of a primary pleuritis in these patients. Cyanosis in such patients was usually an early feature. The pathological process was so extensive, the exudation so rapid, as a result of the widespread fibrinous pleuritis, that little could be done, except repeated aspirations, for these unfortunate patients.

Later in the course of what has many times appeared to be an uncomplicated pneumonia, if the fever persisted, the pulse-rate elevated and the respirations were increased an encapsulated empyema was located. If one recalled to mind the five most common complications as a cause of death in pneumonia which had

progressed beyond the acute stage, diagnosis of the cause of death was much facilitated. These were:

1. Empyema with possible peritonitis.
2. Spread of pneumonia to the opposite side.
3. Pericarditis, serofibrinous or purulent.
4. Nephritis.
5. Substernal pus pockets (in the interstitial types of streptococcic pneumonia following measles and scarlet fever) and lung abscess.

TREATMENT. In performing the repeated aspirations one may expect the fever, pulse-rate and many times the respiratory embarrassment to diminish. We have been guided by four points in deciding upon the proper time for operation in a unilateral empyema: (1) the quantity and character of the pus; (2) the type of infection;



FIG. 7.—Resolving pneumonia, with opaque area, due to interlobar empyema, right side.

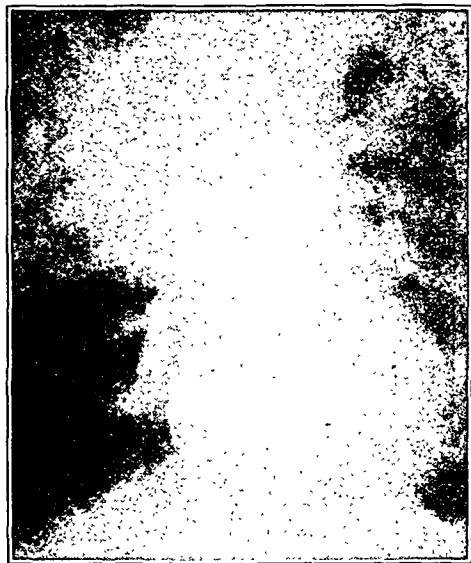


FIG. 8.—Localized empyema of right apex.

(3) the presence or absence of complications; (4) the length of time necessary to show improvement in the general condition of the patient under the aspirations. It will be noticed in Table 15 that an average of six aspirations were performed and that the average was about nineteen days before operation for the patients of the second series. In Table 21 it will be noticed that the average number of aspirations was 3.7 and that the interval before operation was 13.5 days for the patients of the third series. In individual patients the average length of time before operation in the second series was longer than may have been necessary. It is probable that the high mortality of the first series had made us unduly conservative.

The time for operation will in general depend upon the four factors mentioned above. Five aspirations during a period of twelve to

fourteen days, if the patient has shown improvement, will constitute an average. Operation may, with greater safety, be longer postponed upon a patient with pneumococcus than streptococcus infection. The older teaching that a pneumococcus empyema would recover by aspiration should be revised. In the 35 patients who recovered by aspiration alone a pneumococcus empyema was present in 9, or 25.7 per cent. One of the patients who recovered without operation had bilateral empyema due to pneumococcus infection. A total of nineteen aspirations were performed upon him, with recovery; 35, or 11.3 per cent., of the 310 patients here reported, recovered without operation. This closely corresponds with the figures from Camp Lee (13 per cent.) mentioned by Major Graham and Captain Bell.¹⁶ It is probable that our records of the aspirated



FIG. 9.—Encapsulated empyema, right, ten days after drainage operation. Oper. Series III, No. 53. Recovery.

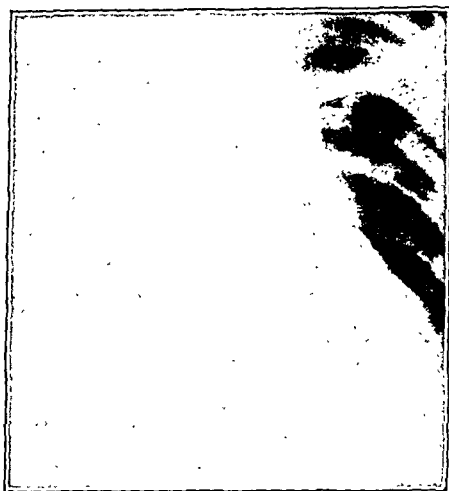


FIG. 10.—Empyema, right, with displacement of heart to left. Note shadow in median line, due to probable substernal pus pocket. Oper. Series III, No. 26. Recovery.

recoveries are incomplete, since many patients recovered from whom pus was aspirated in small quantity upon one or two occasions, of whom no record of empyema was kept for the purpose of this study.

In performing the aspirations, when the pus was thick and because of some complication such as an active pneumonia on the opposite side or a bilateral empyema, operation did not at the time appear advisable, intrapleural lavage, using sterile saline solution, was performed at the time of aspirations in order to dilute the pus and permit of its aspiration. The apparatus consisted of a Potain aspirator, the rubber tubing from which connected with one arm of a three-way stopcock, to another arm of the stopcock was attached a portion

¹⁶ AM. JOUR. MED. SC., 1918, clvi, 839.

of rubber tubing and the aspirating needle, while to the third arm was connected a portion of rubber tubing with a bottle containing the warm saline solution. Through the rubber cork of this bottle a glass connection was attached to a rubber bulb, pressure of which forced the saline solution from the bottle through the tubing. After the aspirating needle was inserted as much pus as could be aspirated flowed into the bottle. The stopcock was then turned so as to connect with the bottle containing the saline solution. By pressure on the bulb, saline solution in quantities of 200 to 300 c.c. was forced through the aspirating needle into the chest cavity. The stopcock was again turned and the diluted pus aspirated into the vacuum bottle. In this manner quantities of pus varying in amounts from 400 to 800 c.c. could be removed in excess of the amount secured by the first aspiration and in excess of the amount of saline solution introduced.

At the time of operation the patient received hypodermically one-eighth grain of morphin and one-two-hundredth grain of hyoscin one hour before going to the operating room. This was repeated one-half hour before the operation, except in markedly weakened patients. General ether anesthesia has been proved safe for these patients in the absence of an active pneumonic process and upon whom a number of aspirations have been performed. This was especially true if after the ether anesthetic the lungs were thoroughly ventilated of ether vapor by oxygen inhalation with the closed cone for about five minutes. Recovery from the anesthetic occurred rapidly and no ill effects from the ether were evident subsequently. Except for a few of the patients in the first series, empyema cases have remained in special wards of the pneumonia sections under the care of the medical service. They have been operated, by a surgeon assigned for this duty, by the chief of the surgical service, in special operating rooms of the pneumonia sections, which rooms were also used for the daily dressings. The aspirations were performed by the medical officers who cared for the patients during their attack of pneumonia. Since the causes of death subsequent to operation were those resulting from medical complications, the patients remained under the care of the officers of the medical service who had been familiar with the course of the illness from the time of its onset.

The attempt was made at the time of operation to secure copious drainage for the first forty-eight hours by means of a single large drainage tube (about four inches long and three-quarter-inch inside diameter), after which, in many patients, the modified Brewer tube, with Ewald suction bulb and Carrell tube for irrigation, shown in Fig. 11, was inserted. The skin opening should not be much longer (about two inches) than the width of the flange on the Brewer tube. While this small incision made it more difficult for the operator to resect one-inch of rib, it was possible to fit the Brewer

tube tighter and better negative pressure by the suction of the Ewald bulb could be secured. At the present time no irrigation is used for the first forty-eight hours. At the end of that period irrigation is carried out by means of the apparatus as shown in Fig. 12. Neutral solution of chlorinated soda in quantities of 100 to 300 c.c., depending upon the size of the cavity, was allowed to flow in or was injected by means of a hand syringe, every two hours. Suction was

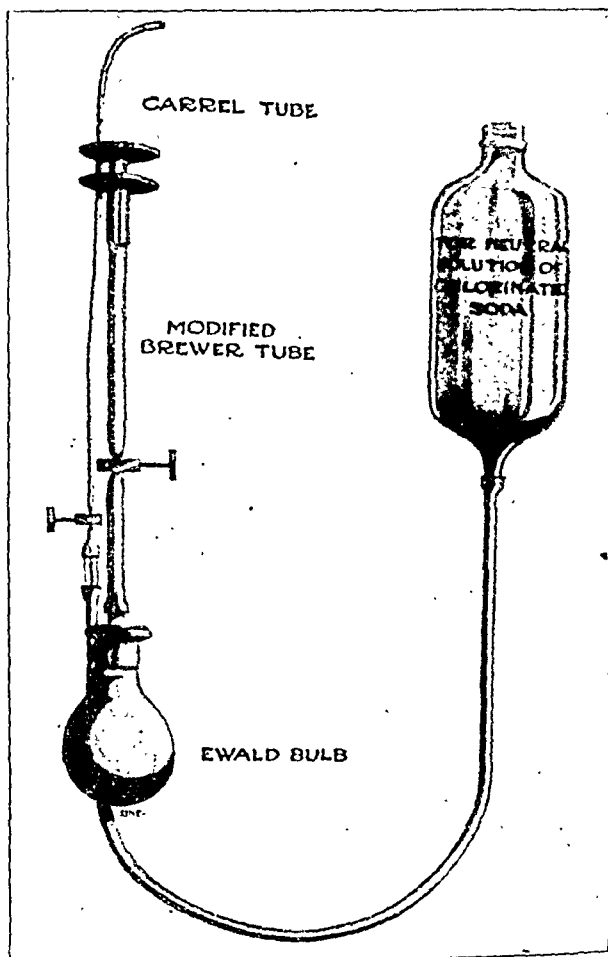


FIG. 11.—Apparatus for continuous or interrupted empyema irrigation and suction as used at U. S. Army Base Hospital, Fort Riley, Kansas.

secured at the end of two hours to remove the solution and pus before the fresh solution was placed in the cavity. At the end of the first week suction was more or less continuously employed and one daily irrigation in the dressing room substituted for the continuous irrigation in the wards. Pain contra-indicated suction. Irrigation with the neutral solution of chlorinated soda was contra-indicated if a communication with a bronchus was suspected. It has not been necessary to have any extensive secondary operation performed for

large open pneumothorax or cavity in any of these patients, although sequestrectomy for a small portion of necrotic rib and dissection of the sinus was necessary in a few patients.

The daily irrigations were, as a rule, continued until pus was absent. The Brewer tube was removed after two weeks and gradually decreasing sizes of plain rubber tubing substituted for drainage purposes. The count of the number of bacterial cells per field from smears of the discharge as an index to the efficiency of the irrigation has given in our hands no more definite information as to the safe time for closure of these wounds than the clinical evidences. As



FIG. 12.—Apparatus in position for irrigation and suction in empyema.

the size of the opening of the pneumothorax diminished the lung was able to resume expansion. The ability of the lung on the affected side to expand determined to large degree the extent of drainage and the obliteration of the empyema cavity. Posture in bed and suction assisted drainage, but drainage was greatly facilitated if expansion of the lung could occur. The external opening should therefore be decreased in size as rapidly as possible by substituting smaller-sized tubes sufficiently large for drainage and irrigation.

The postoperative dressings required rigid surgical cleanliness to prevent secondary infection of the pleura, a condition particularly liable to occur. A high calorie diet was used to make up for the

extensive tissue waste which accompanied the chronic sepsis. A diet of 3500 to 4000 calories could be readily secured by augmenting the regular or special diet with carbohydrates and fats.

Trocar drainage of empyema has not been satisfactory in our hands. If used during the course of an active pneumonia for the drainage of thin pus, danger of an open pneumothorax was constantly present if the patient was delirious, and, because of the pain caused by the presence of a metal tube, attempted its forcible removal. If used at a later stage, when the pus had become thickened, the lumen of the cannula was insufficient in size to drain the larger masses of fibrinous exudate so commonly present. The use of neutral solution of chlorinated soda as an irrigating fluid would in many cases liquefy these masses and permit drainage through a relatively small-sized tube. In other cases masses as large as the palm of the hand could only be successfully removed through a costectomy opening. Repeated aspirations for empyema as used in this hospital since January 12, 1918, fulfil the necessary requirements during the acute stage of pneumonia and have obviated the danger of an open pneumothorax. Later, when limiting adhesions have lessened the danger of communication with the free pleural cavity, and have, to greater or lesser degree, immobilized the mediastinum, costectomy could, with relative safety, be performed. It is now recalled that patients who have given the greatest anxiety have been those with displaced heart in an open pneumothorax. Such displacement had occurred as a result, we now know, of mobility of the mediastinum brought about by pressure changes on the side of the open pneumothorax which had affected the expansion capability of the lung on the opposite side.

Because of the interest attached to a comparison of clinical facts and experimental data, those who are interested should read the excellent article by Major Graham and Captain Bell (*loc. cit.*); in which it was shown experimentally that the pressure changes brought about by an open pneumothorax affected not only the lung on the side of the opening but affected in similar degree the opposite lung, due to the mobility of the mediastinal structures. As has been stated by them, the normal thorax may be considered as one cavity instead of two. They have expressed the belief that the dangers of an open pneumothorax are much lessened after adhesions have formed which immobilized the mediastinum. The formation of such adhesions has been favored by the late operation as well as more adequate air space in the lungs resulting from the subsidence of the pneumonia and decreased bronchial exudate.

The bearing of such facts upon the treatment of empyema is obvious, facts which, it is believed, have been verified clinically by the results secured for those patients, here reported, upon whom the late operation had been performed.

The average incapacity from empyema necessitating drainage will

probably be not far from three months. Recovery has in some patients taken place in four to six weeks, but many other patients have required four to six months. Two or three of the patients in the first series had small costal sinuses after one year.

The writer has been under constant obligation to many officers who have earnestly coöperated in this work, especially to Major B. G. Phillips, Captains W. P. Bliss, W. S. Binford, W. M. Stout, C. W. Zugg and J. H. Armstrong, Lieutenants C. L. Morris, A. B. Schwartz, P. S. Murphy, C. S. Mundy, G. F. Zachritz, S. T. Nicholson, Jr., G. M. Purves, W. A. Meierding, H. A. Kirkham, C. L. McLaughlin and A. F. Watts; to Captain E. S. Cummings and Lieut. G. H. Cooper for roentgenographic assistance; to Major O. F. Broman, Captain R. L. Benson and Captain W. Levin of the Laboratory Staff, and to Captain H. W. Cattell, Lieutenants F. K. Bartlett and A. A. Smith for necropsy notes.

SCLERODERMA AND SCLERODACTYLY: REPORT OF A CASE, WITH ROENTGEN RAYS AND REVIEW OF THE LITERATURE.

BY REGINALD M. ATWATER, M.D.,

BOSTON, MASSACHUSETTS.

(From the Medical Clinic of the Peter Bent Brigham Hospital, Boston.)

CASES of scleroderma and sclerodactyly, with roentgen-ray studies of the bony changes, are infrequent enough in the literature to justify the reporting of a case. The case here recorded is that of a Jewish woman, aged fifty years, who entered the medical wards of the Peter Bent Brigham Hospital on December 16, 1918 (Med. No. 10,081), complaining of stiffness of the joints, particularly in the hands, but also generally throughout the body.

The present illness has begun one year previously, with stiffness in the shoulders, which later appeared in the hands and arms and in turn in the back and legs. Four months previous to her entrance she had pain in the neck about the ear, most marked on the left side. She complained of particular difficulty on the left side of the whole body. There was considerable aching pain throughout the affected parts, which was worse at night. During the two weeks preceding entrance the pain had become much worse. Although she refers all the pain to the joints, her difficulty is best described as a general stiffness of the extremities themselves and not wholly as a joint affair. The onset of the thickening in each new spot is preceded by an itching, papular eruption, lasting several days.

Within the preceding few weeks she had become much weaker and had lost her appetite. She was very miserable and had found no relief in the various treatments which several physicians had advised, consisting of liniments and electrical applications. Except as above, she had developed no new cardiorespiratory, gastro-intestinal, genito-urinary or neuromuscular symptoms during the present illness.

Apart from these symptoms, and quite independent of them, she had developed during the week before entry some cough, with severe headache, backache and increase of her malaise. The onset, course and symptoms corresponded in general to a mild attack of influenza.

Family History. The family history, although incomplete because her home was in Russia, is significant in recording a sister, who when last heard from several years ago was troubled with stiffness of the skin. This sister probably has since died. Her father is living, health unknown. Mother died of an unknown cause at an advanced age. Four brothers and five sisters supposedly are living and well. There is no family history of cancer, diabetes, gout, tuberculosis, arthritis or diseases of the circulatory, respiratory, digestive, renal, nervous or muscular systems.

Marital History. Husband is living and well. Six children are living and well. One child died at one year, cause unknown. There was one miscarriage at five months with the first pregnancy.

Habits. No addiction to tea, coffee, alcohol or drugs.

Occupational History. She has kept house for herself and family since marriage and has worked hard.

Past History. She was born in Russia, coming to America seventeen years ago and never living outside the temperate zone. Although her memory is fair, she could not remember having had chicken-pox, smallpox, measles, mumps, whooping-cough, influenza, chorea, rheumatism, pleurisy, pneumonia, scarlet fever or typhoid fever. No known association with tuberculosis. The patient remembers no other diseases. No injuries or operations.

Head. Headaches have been rather frequent for many years, frontal in type and fairly severe. *Eyes:* Glasses have been worn for reading for many years; no history of failing vision, inflammation or pain. *Ears:* There is no loss of hearing, pain or discharge. *Nose:* There has been a chronic postnasal catarrh without history of frequent head colds, epistaxis or symptoms of obstruction. *Teeth:* Always have been rather poor and neglected, but no positive history of dental abscess was obtainable. *Throat:* There has been occasional tonsillitis, but no history of hoarseness or sore mouth.

Cardiorespiratory. The patient thinks she may have had some edema of the ankles for the past year. No history of pain in the chest, palpitation, dyspnea, cough, sputum, hemoptysis or night-sweats.

Gastro-intestinal. Appetite always has been very poor. Habits of eating are very irregular. Bowels never move without a cathartic. There has been mild distress in the epigastrium after eating. No history of nausea, gas, vomiting, hematemesis, colic, icterus, diarrhea, bloody, tarry, or clay-colored stools or of hemorrhoids.

Genito-urinary. Nocturia once or twice has been present for a number of years. No history of hematuria, pyuria, retention or incontinence is obtained; no satisfactory venereal history is obtainable by name or symptoms.

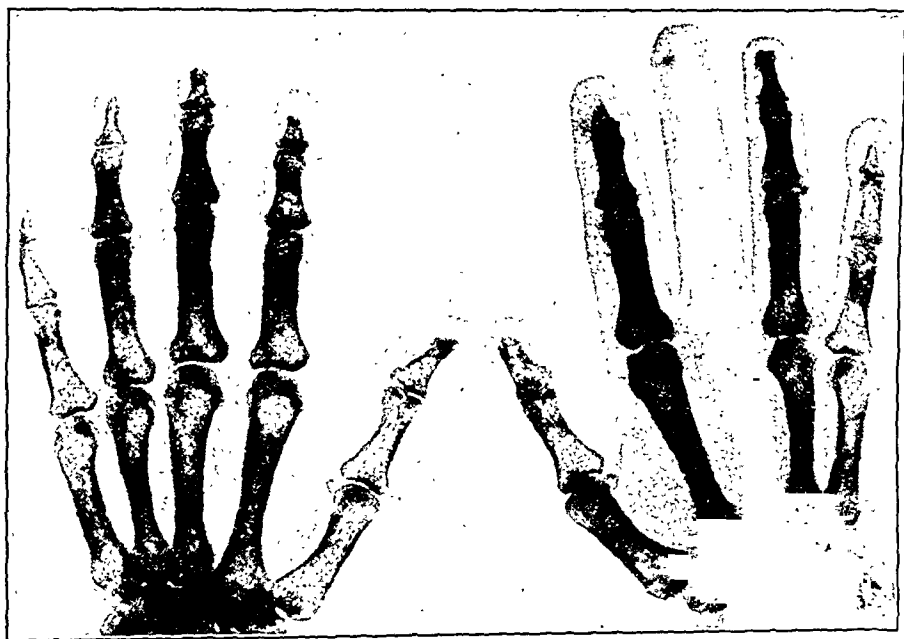
Catamenia. Onset was at eighteen years; have always been quite regular, lasting five days. Last period occurred two years ago, at the age of forty-eight years, without particular symptoms.

Neuromuscular. Sleep has been very poor. She has always been of a nervous disposition, but this has been much accentuated by the present illness. There has been dizziness and occasional fainting and coldness of the extremities, particularly in the present illness. No shooting, muscular, girdle or joint pains. Memory is fair. Temperament very irritable.

Weight. Has been about 110 pounds for years. Present weight 90 pounds.

Physical Examination. The patient shows striking characteristic appearances, recognizable at a distance. The color of the skin is of a generally uniform brown, about equal in tint to that of the average Japanese. There is a peculiar marbly hardness of the skin, associated with a glossy luster, most marked over the face, neck, wrists, ankles and in the small of the back. There is a marked resemblance to the dried skin of a cadaver. There is an expressionless appearance to the face, the lines being obliterated. The hands show moderate general swelling of the fingers as contrasted to the upper half of the hand, along with atrophy of the interossei. The ends of the fingers appear thickened and shortened, much as if they had been chopped off. All of the finger-tips have a thinning of the skin into a parchment-like membrane, associated with some scarring and a marked pallor of the tips as contrasted with the adjacent skin. Over some of the knuckles there are areas of paler skin and along the dorsum of the fingers there is some mottling of the pigment. The skin over the backs of the fingers is smooth. The folds at the joints are less marked than normal. It is almost impossible to pick up a fold of the skin over the fingers or hands. On the palms there is a slight degree of brownish pigmentation. The lines on the palms of the hands are marked and are definitely more pigmented than the adjacent skin. The fingers can be only partly flexed, evidently because of the thickening of the skin, and not due to any change in the joints, as the joints are freely movable on passive motion until checked by the tenseness of the skin. The thickening of the skin is less on the upper arms than below and less on the flexor than on the extensor surfaces. Thermal sense is not disturbed over any portion of the body. This

same type of skin is present over the face and neck and to a less extent over both ankles and feet. The toes in a small way resemble the fingers. One finger-nail is very much thickened, dark in color and irregular. The other finger-nails show slight thickening and linear corrugation. The toe-nails show practically no changes. These features are essentially symmetrical and no areas resembling isolated morphea are found. Otherwise the physical examination shows hair that is somewhat coarse; the mucous membranes are somewhat pale; there is no buccal pigmentation; the teeth are very poor indeed; the neck is stiffly moved because of the inflexible skin of the neck; there are no palpable lymph glands; the lungs show a few medium, sticky rales of the type seen in influenza. Otherwise the chest is normal. The heart findings are negative. The vessels show just a little sclerosis. There is no hypertension. The abdomen, extremities and reflexes are negative.



The urine showed no albumin or sugar in three examinations, but a few hyaline and granular casts and white blood cells were found. The hemoglobin was recorded as 50 per cent. There were 3,400,000 erythrocytes and 8000 to 9000 leukocytes. The differential smear showed polymorphonuclears 66 per cent., small lymphocytes 28 per cent., large mononuclears 5 per cent., and eosinophiles, 1 per cent. The red cells in the smear showed variations parallel to their reduction. The stool examination was negative. The Wassermann reaction on the blood serum was negative.

Roentgen studies of the hands show definite bone atrophy and absence of the tips of the terminal phalanges of the second, third,

fourth and fifth fingers of both hands and partial destruction of the same phalanx of both thumbs. Studies of the skull and the sella showed negative findings. The basal metabolism on December 20 showed findings 1 per cent. above normal.

Histological study of a piece of skin removed from the small of the back in a sclerosed area on December 20 showed a considerably increased thickness of the corium, the connective tissue of which showed dense and, in places, hyaline collagen. The epidermis was of normal thickness and contained in the basal layer more than the average amount of brown pigment. Immediately beneath the epidermis the connective tissue was of much more delicate structure. The collagen bundles were small, loose textured and there were occasional apparently active fibroblasts. The coil glands were normal. There were a few normal-appearing hair follicles in the specimen. The subcutaneous fat was normal in appearance. The connective-tissue septa between the fat lobules were somewhat heavier than normal. There were small arteries, veins and nerves in the specimen, all of which had a normal histology.

The patient remained on the ward for one week, during which time she had an essentially normal temperature and respiration rate. The pulse-rate varied between 80 and 130 without obvious cause. The signs suggesting influenza cleared up without further event. She developed an eruption, said to be similar to that usually preceding the thickening, over one eyebrow, where there was very slight involvement of the skin. This eruption consisted of a very few scattered papules of a pink color on a slightly reddened base, which showed scaling for several days. Attempts at relief of the symptoms by hot baths and massage were not successful subjectively. She was given thyroid extract in doses of from 0.065 to 0.13 gram and was advised to continue on the smaller dose three times a day. She left the hospital without any signs of improvement. After two months of the thyroid therapy it is stated: "It does not do her any good; in fact, she feels worse than ever. Her legs and arms are stiffer than formerly and she is very weak. She is starving herself."

A search of the available literature covering the features of the sclerodactyly as shown in this case has produced about 15 reported cases in which particular mention and study have been made of the sclerodactylism. Of course, this is a small portion of the total of scleroderma cases, many of which have been complicated by sclerodactyly. The sclerodactyly is often considered as characteristic of one form of scleroderma—the diffuse, symmetrical, atrophic type. Thirty-four years ago Lewin and Heller¹ collected 500 cases of scleroderma, and since that time many cases have been recorded.

So far as can be ascertained the first radiographic study of this process is that noted by Fordyce² in 1907. During the same year

¹ Die Sclerodermie, Berlin, 1885.

² Case of Sclerodactylitis, Jour. Cut. Dis., 1907, xxv, 90.

Pollitzer³ and Fox⁴ each published cases with very similar roentgen-ray findings. Subsequent reports by Jamieson,⁵ Weber,^{6 7 8} Stowers,⁹ and Bertolotti¹⁰ are essentially the same. All showed deformity, atrophy or disappearance of the terminal phalanges in the hands. The joints seem to be rarely involved.

This process in the bones is practically limited in the reported cases to the terminal phalanges of the hands, and, much less frequently, of the feet also. The proportion of hand-and-foot involvement seems to bear a general parallelism to the relative frequency of the sclerodermic changes in the hands and feet. In Osler's series¹¹ Case XIV showed bone atrophy in all the bones of the left upper extremity, including the scapula. One of Weber's cases⁷ showed marked atrophic changes in the bones of the face, over which there was an extensive scleroderma. In none of these cases of sclerodactylism was the scleroderma of the patchy morphea type. There seems to be a doubtful relation between the process in the skin and that in the bone. Though both are essentially atrophic they appear to be quite independent of each other. (Olsen.¹²)

Cases are reported in age from a case (Cockayne¹³) one year old, which had an antenatal origin to cases more commonly in the fifth and sixth decades. The predominance of the Jewish race in this series of cases, as in all of scleroderma, is very striking and also the frequent associated symptoms of Raynaud's disease and arteritis obliterans.^{4 6 7 8 14} One case is reported associated with past and family history of angioneurotic edema by Savill.¹⁵

Pollitzer¹⁶ reports ossification in the skin and Olsen¹² reports the finding of calcareous concretions in the skin of scleroderma.

Fox¹⁷ in a review of the sclerodactyly type of scleroderma finds a distinctly decreased glucose tolerance.

³ Sclerodactylia, Jour. Cut. Dis., 1907, xxv, 280.

⁴ Two Cases of Raynaud's Disease with Ocular Symptoms; One Case Complicated by Scleroderma, Jour. Cut. Dis., 1907, xxv, 337.

⁵ Generalized Scleroderma with Sclerodactylia, Med. Jour. Australia, 1917, ed. I, p. 505.

⁶ Two Cases of Sclerodactylia, British Jour. Dermatol., 1915.

⁷ Case of Generalized Atrophic Scleroderma with Sclerodactylia, Proc. Roy. Soc. Med., 1915, Dermat. Sect., part I, viii, 126.

⁸ Sclerodactylia of Feet Associated with Arteries Obliterans and Gangrene of Toes, Proc. Roy. Soc. Med., 1915, Clin. Sect., part I, viii, 52.

⁹ Note in article of Weber (7).

¹⁰ Etude radiologique d'un cas de sclerodermie. Analogies de la sclerodermie avec la syndrome de Profichet, N. Iconog. de la Salpêtrière, 1913, xxvi, 291.

¹¹ Osler and McCrae's Modern Medicine, iv, 1016.

¹² Sclerodactyly with Calcareous Concretions, Jour. Cut. Dis., 1917, xxv, 96.

¹³ Scleroderma with Sclerodactylia of Anatomical Origin in an Infant, Proc. Roy. Soc. Med., 1915, Sect. Dis. Child., part I, viii, 72.

¹⁴ Rolleston, H. D. and Carpenter, G. D. H.: Scleroderma with Sclerodactyly, Proc. Roy. Soc. Med., 1910, Clin. Sect., part I, iii, 32.

¹⁵ Case of Scleroderma of the Extremities with Angioneurotic Edema, Proc. Roy. Soc. Med., 1909, Clin. Sect., part I, ii, 200.

¹⁶ Ossification in the Skin in a Case of Scleroderma, Jour. Cut. Dis., 1918, xxxvi, 271.

¹⁷ Case of Scleroderma (Sclerodactyly Type), Jour. Cut. Dis., 1917, vol. xxxv; Tr. New York Dermat. Soc., May, 1916, p. 43.

A previous assertion of the relation of scleroderma with syphilis would appear to be set aside by the high percentage of negative Wassermann reactions in this group.¹⁸

In summary this case of scleroderma possesses many features very characteristic of the disease in its usual form. The associated sclerodactyly appears quite typical of those cases previously reported in which radiographic studies of the bones have been made. There is a characteristic atrophy, absorption and eventual disappearance of the terminal phalanges most commonly in the hands and sometimes in the feet.

NEUROCIRCULATORY ASTHENIA (SOLDIERS' HEART).

BY JOHN H. CARROLL, MAJOR, M.C., U.S.A.,

MEMBER OF THE TRENCH FEVER WORKING PARTY, ROYAL ARMY MEDICAL COLLEGE,
LONDON.

IF one may judge from the literature on soldiers' heart, this syndrome, the original description of which we owe to Da Costa, has been the most studied of the diseases of the war. The English school of MacKenzie and Lewis early recognized the functional basis of the syndrome and did much to rob the disease of the great terror and fear of impending dissolution with which the lay victims contemplated it. It redounds much to the credit of the school of clinical observation, of which MacKenzie is the great exponent, as opposed to that of abstract scientific analysis, that the tachycardia, breathlessness, murmurs, etc., were not considered in those days indicative of organic changes in the heart. Although definite progress in the treatment of some variety of these conditions has been achieved by the Lewis school, there is no agreement, in our opinion, either in the etiological factors concerned in the causation or the pathogenesis of the syndrome. When the reports on soldiers' heart in the American draft army became available, two very striking facts were apparent:

- 1. That this condition was not an uncommon symptom-complex of civilian youths, much intensified by the conditions attending the early stages of the draft.

2. That the etiology of these cases did not altogether agree with the etiological factors believed to be responsible for the cases developing on active service.

In reviewing the literature on soldiers' heart, we are forced to ask the question, "Have we quite exhausted, in our analysis of the

¹⁸ Osler, Wm.: On Diffuse Scleroderma with Reference to Diagnosis and Use of Thyroid Gland Extract, *Jour. Cut. Dis.*, 1898, xvi, 49 and 127.

symptomatology of soldiers' heart, the possibilities in pathogenesis and their relation to the etiological factors believed to be the cause of the condition?" We believe not.

Sir James Barr, from 1916, gave us in the literature what he considered sufficient facts to establish the entity of soldiers' heart as hyperthyroidism.

Harlow Brooks, from his study, concluded that the condition was one of hyperthyroidism. Robey and Boas believed the cause to be "a fundamental instability of the patient, that cannot be cured." McFarlane found his group of men had been subjected for many years to a low-grade infection.

Lewis considers infection the predominant etiological factor in the syndrome.

From this array of opinion we are offered three etiological factors: (1) hyperthyroidism, (2) constitutional instability, (3) infection; and we propose to attempt an analysis of these factors in relation to what we believe to be the pathogenesis of the disease.

That the disease was hyperthyroidism is a theory which comes to us supported by such sound clinical judgment as Harlow Brooks in America and Sir James Barr in England, both of whom described in the picture palpable thyroid enlargement as well as the clinical phenomena common to hyperthyroidism. Many other observers agree with this view. Lewis and his school dispose of the theory of hyperthyroidism after failure to demonstrate a more or less constant palpable thyroid enlargement. We believe this inadequate ground for dismissal of the theory: (1) because the personal factor in deciding the presence or absence of thyroid enlargement is a very considerable one, and (2) because no one has, to our knowledge, noted palpable thyroid enlargement as a more or less constant finding among the troops in France; yet McNee and Dunn found the average weight of the thyroid from sixty-five men killed in action 26.7 grams, a figure notably above the normal for civilian males of corresponding age. Again, palpable thyroid enlargement is a doubtful criterion of hypersecretion of the thyroid gland; even in Basedow's disease we have the authority of Murray, that a large percentage of the glands are not noticeably enlarged.

When we leave the debatable ground of thyroid enlargement and approach the symptomatology of the two conditions we see a strong justification for the supporters of the hyperthyroidism theory.

There is a striking similarity in the clinical phenomena of the two conditions, and if we disregard the signs in Basedow's disease known to be due to stimulation of the superior cervical the phenomena are identical. These phenomena are attributable to a hyperirritability of the opposing sets of fibers in the autonomic nervous system, and include the following:

- (a) Epiphora Loewi 0.5 phenomena; excess or lack of saliva.
- (b) Asthmatic dyspnea or tachypnea.

(c) Tachycardia, pulsus irregularis and respiratorius, vasomotor angina.

Subjective palpitation. Transitory change in blood-pressure.

Vasomotor symptoms, especially transitory erythema and dermatographism.

(d) Gastropasm, pylorospasm, gastric hyperacidity, spastic constipation.

Unmotive watery movements, painless diarrhea, unmotive vomiting.

Pollipiuria, polyuria, oliguria.

Profuse sweating. All domain under autonomic control.

There is a growing opinion among students of Graves's disease that we have too long been concentrating our attention on the cardinal triad and too little considering the other phenomena of the disease, and that we have, in the words of Pottinger, been confusing several different entities in our cases of Graves's disease.

The type of Eppinger and Hess, described as sympatheticotonic and characterized by marked exophthalmos, epinephrin mydriasis, Möbius's sign, dry eyes, no sweating, no diarrhea, is a definite entity. These phenomena are attributable to stimulation of the sympathetic fibers whose motor cells lie in the cervical sympathetic, and there is a striking absence of phenomena which lead to the parasympathetic system. For the firm foundation to the pathogenesis of this type we owe much to the researches of the pathological department of the Mayo school, as the following extract from the reports of Wilson and Durant would attest: "It would appear from our examination by the method detailed that definite histological changes do occur in the cervical sympathetic ganglia in hyperplastic toxic (exophthalmic) goitre, and, further, these histological changes consist of various states of degeneration, viz.: (a) hyperchromatization, (b) hyperpigmentation, (c) chromatolysis and (d) atrophy of the nerve cells. All these are but successive steps in degeneration, which, if uninterrupted, proceed to the complete destruction of the ganglion cells affected. Not all of the ganglion cells in any of the ganglia examined were so completely destroyed as to render impossible their return to normal, under favorable conditions. There is some evidence that in ganglia, from cases clinically improved, some of the cells have partially or wholly recovered.

After separating cases of this type from the syndrome of Graves's disease we have left a greater group in which the symptomatology is attributable, in great part, to tissues supplied by the autonomic nervous system. Particularly is this so in cases of hyperthyroidism without frank exophthalmos. In such cases, if we except the thyroid increase, all the phenomena may be attributed to hyperactivity of the greater vagus system. It does not appear possible to us that hypersecretion of the thyroid autocoid can explain these striking differences in clinical pictures.

Let us examine the autonomic nervous system. All tissues in the domain of this system have a double innervation. Normally, there is a stable balance between the innervation of one set and the other set of fibers in this system. In both diseases under discussion there is a hyperactivity of both sets of fibers, and the problem in the study of the pathogenesis is the determination of the mechanism and causation of this hyperirritability. It has long been assumed that the autocoid of the thyroid is responsible for the irritability of this system. It was explained that thyroid sensitized or lowered the threshold of these nerve fibers. Recently, considerable doubt has crept into the literature on the subject, as Pottinger's able analysis of the syndrome will show. The supportive proof of thyroid sensitization of any portion of the autonomic system is bound up in the thyroid adrenal interrelation. This is one of mutual stimulation in which the thyroid secretion sensitizes sympathetically innervated tissues to the action of adrenalin; but it is not clear that this action is more than its effect on the pressor fibers in the presence of adrenin. And, again, in weighing this fact we must keep before us that the balance of proof is against there being adrenin in the blood in other but extreme emergency. A much stronger argument against the sensitization theory of the thyroid autocoid is the failure of Levy to demonstrate any effect on the vagus system.

The other commonly accepted explanation of the signs of hyperirritability was that it was due to an adrenalemia. It was believed that a greater than normal outflow of adrenin increased the irritability of the sympathetic fibers, and that, as a result, in attempting to maintain an equilibrium in the autonomic system, a compensatory hyperirritability of the opposing mechanism resulted. This view we believe untenable in the light of our present knowledge. In addition to a stimulation of the tissue supplied by the sympathetic adrenin renders inactive the opposing mechanism. This is illustrated in the musculature of the gut, the bladder and the blood supply of the kidney. Here in the presence of adrenin essential functions may be carried on, but by the action of the autocoid of the pituitary. This requirement of the organism in the presence of adrenin of other autocoids is well illustrated by the part the thyroid plays. Hoskins and McClure show, by a study of the adrenal effect on the arterioles of the body, that the net effect of pure adrenal activity is not a pressor effect on systemic blood-pressure, and the work of Levy demonstrates that the pressor effect formerly accredited to adrenin is realized by the secretion of the thyroid gland which Cannon and Cattell show is mobilized in the blood in the presence of adrenin. There is little opposition to the consensus of opinion among leading endocrinologists of today that adrenin is present in the blood only in states of emergency, and it is a fair deduction from the foregoing discussion that in the presence of the emergency its action is to supplant rather than to support the involuntary nervous system and in the maintenance of an equilibrium, in the absence of involuntary

nervous activity, it is supplemented by other autocoids. We do, however, believe adrenin may play a part in precipitating the syndrome, and in such a way as will be analyzed later in the paper.

We believe, from the foregoing comment, that we are justified in the assertion that there is a definite need to search further than the autocoids of the thyroid and adrenal for the cause of the disturbance in the autonomic nervous system, and particularly should this scrutiny be directed to factors operating in the causation of the predominant vagal phenomena. Further, it seems reasonable to consider the thyroid secondary, and in some instance compensatory to a derangement which finds origin in the vegetative nervous system.

The theory that inherited constitutional predisposition is a factor in the development of instability of the autonomic nervous system is undoubtedly on a sound basis. The vagotonic and sympathetico-tonic types of individuals described by Eppinger and Hess are familiar to us all, and it is clear that this predisposition determines the predominance of one of the other set of symptoms in the autonomic system in some cases of Basedow's disease. The part that inherited instability plays in the etiology of neurocirculatory asthenia is probably better illustrated in the studies of the American draft army than in any other group of cases. Both the studies of Robey and Boas and Brooks emphasize this point. Among the draft troops the etiology in the cases was uncomplicated by the many factors of active service known to play a part in the causation of the syndrome. While we agree with Robey and Boas in the conclusion that inherited constitutional tendency is a definite factor in the causation of the syndrome, we cannot agree that all cases are attributable to an inherited constitutional tendency, and that they cannot be cured. This understanding of the causation fails to explain the great number of cases that have developed among men who long flourished in good health on active service in France. Oppenheimer emphasizes this, that 39 per cent. of the group studied at Colchester had absolutely negative histories and had given valuable military service before breaking down. It is safe to say that infection may be the determining etiological factor among the greater number if not all the cases developing among men on active service. This brings before us the question of infection as a cause of autonomic nervous instability. In our work with trench fever, which was by far the most common infection in the troops, we found unmistakable evidence of hyperirritability in this system. The men ill with trench fever uniformly evidenced marked vagal phenomena during the febrile and convalescent stages. Approximately 85 per cent. of cases of trench fever recovered promptly after the febrile illness. The remaining number gradually passed through a subacute on to a chronic state of illness, characterized by irregular low-grade fever, varying degrees of splenic enlarge-

ment and a group of nervous phenomena characterized by hyperexcitability of the voluntary and involuntary nervous systems, catalogued clinically as neurasthenia and D. A. H. The deduction from a study of these cases is that the infection was responsible, in the first instance, for the vagal phenomena, and with the cure the patient was rid of the organisms. In the second group the deduction was that the persistence of the infection maintained a hyperirritability of the vagus system and that the attempts of compensation in an equilibrium consistent with a lower plane on the individual resulted in the clinical picture of the chronic disease, or what has been called effort syndrome in some instances, neurasthenia in others. That this picture indicates a chronic infection, in which there is a constant outpouring of the toxins, seems established in the experiments detailed in the following cases:

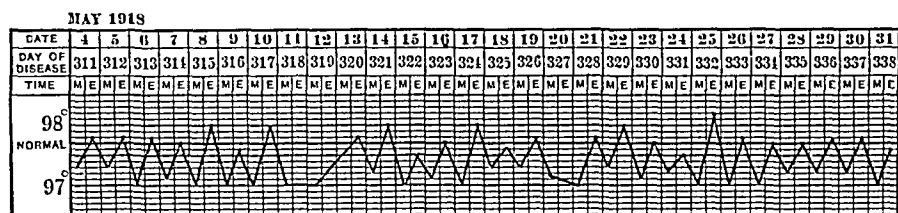


CHART I

CASE 16, aged twenty-eight years, was an A1 man on enlistment, October 12, 1916, and normal during training. To France, April, 1917. On July 5, 1917, he was admitted to hospital with a febrile illness which continued six days and in which he had headache, shin-bone pain and pain in the back. On July 23, 1917, he was invalided to England for pain in the legs, weakness, shortness of breath and giddiness, and during the succeeding months he ran a low grade of fever, with moderate splenic enlargement, chronic muscle and bone pains, especially in the legs, and a progressive nervous instability, with loss of weight and strength. The following is a note of his condition taken from his chart: "Very shaky; sweats freely; flushed face; acute pains in shins; pulse irregular. At night wakes; 'has to fight for breath;' very nervous; sleeps poorly; depressed; frontal headache; breathless on slight exertion; at times dizzy." This is a usual picture of his condition throughout nine months during which he was under observation and in which little result in treatment was realized. In April, a year after his infection, although under hospital care practically the whole time, he presented the picture of a very marked case of neurocirculatory asthenia in which "neurasthenic symptoms predominated."

On the evidence of an eminent authority on neurology this case was transferred to a special hospital under the care of specialists in this branch and returned with a diagnosis of classical neurasthenia.

Clean lice were then fed upon this man throughout the period of the above chart, and following this the excreta from these lice was rubbed into a healthy volunteer who, in the normal incubation period of eight days, developed trench fever. To confirm the experiment further, healthy lice were fed upon the first volunteer who contracted the disease, and by means of their excreta successful transmission to another healthy volunteer was effected.

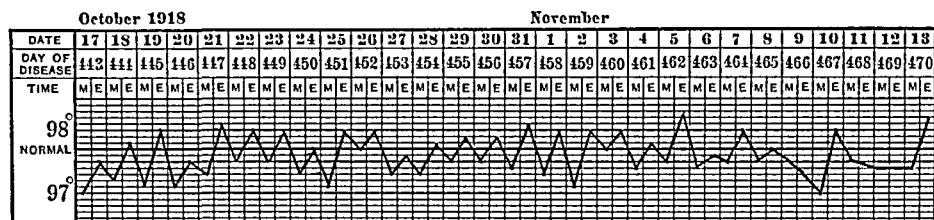


CHART II.

CASE 889, aged twenty-three years, enlisted December 27, 1914; went to France in August, 1915. During training was perfectly fit. Carried on full active duty in France until August, 1917, when he began a febrile illness, with shin-bone pain; pain in back; stiffness of ankles and knees; chills; giddiness. After hospital treatment in France and England he attempted light duty. During the year subsequent he was chronically invalided; in June he was in hospital with a febrile relapse. In September, 1918, he was admitted to the New End Military Hospital with a temperature of 102°; dyspnea; palpitation; giddiness; marked nervousness; frontal headache; shin-bone pain; pain in loins, knees and around ankles; eyes pink; notices he gets worried by trifles; feels depressed without cause; occipital headache constant but of varying severity; heavy over eyes; giddiness.

Jan. 1, 1919. Tâche active red; extrasystoles many, one minute after pulse test; complains of marked depression; lack of interest in life; frontal headache; aching in back of neck; sleeplessness, due to itching of skin; urticarial condition.

Jan. 30, 1919. Breathlessness on exertion since first attack of trench fever; loss of concentration; disinclination to do; effort syndrome poor; marked respiratory rhythm to pulse (sinus irregularity). Extrasystoles after exercise; marked fall in pulse volume in deep breathing.

Lice were fed upon this man during the period of the disease indicated by the above chart and the disease successfully transmitted to a healthy volunteer.

Now let us attempt to find an explanation for the vagotonic phenomena in infectious diseases. Probably the most recent and ingenious theory of disease is founded on Vaughan's experiments. He showed that any kind of fever could be produced and maintained

for weeks by regulating the size and frequency of dosage of protein. The basis of this is anaphylaxis, in which the parenteral reception of foreign proteins so modifies the cells of the body as to develop a special proteolytic capacity for that particular protein, the process of sensitization. This capacity for specific proteolysis is later exercised at a rate and in a degree to produce toxic substances and certain definite clinical phenomena. The exact composition of these toxins is not known. It is believed that histamin is one of them. Their chief influence is exerted in their action on the vagus system or the muscles supplied by it (Schultz). They therefore closely resemble pilocarpin and the other class of vagus irritants. Histamin, pharmacologically, is in the same class as physostigmin, muscarin and cholin and the like, according to Smith. He traces out the action of pilocarpin and the action of anaphylatoxins in two parallel lines, as follows: If pilocarpin is administered to an individual already showing a tendency to vagus excitability a more marked effect is produced than is obtained when the same dose is administered to a normal individual. When we administer anti-toxin for diphtheria to the same type of individual, the vagotonic, we may irritate the vagus system to the point of death, whereas a normal individual is only slightly affected, if at all. Not all vagotonics, however, are susceptible to this exaggerated reaction to horse serum. If one vagotonic reacts to horse serum with symptoms of anaphylactic shock while another does not, manifestly the vagotonic does not in itself determine the response, and a constitutional inferiority of the nervous system does not explain the reaction. The classification of this hyperacute form of serum sickness as an anaphylactic manifestation is not questioned any longer, and the individual displaying it is regarded as sensitized to horse serum. When the shock is survived an anti-anaphylactic state has been observed in some instances. The question may therefore well be asked: "Is not vagotonia in these cases itself an expression of an anaphylactic state, which becomes acute under a specific toxic influence, the same sensitization and previous milder intoxications accounting for the hitherto milder expression of vagotonia?" If such be the case then these phenomena bear a close relationship to the experimentally induced protein fever of Vaughan. The chronicity of the period of sensitization which must be assumed in the vagotonic cases is approximately in Vaughan's experiments.

Smith submits some very substantial evidence that vagotonia, seen clinically, is due to a toxin acting like pilocarpin and histamin, which he considers in most cases an anaphylatoxin. The evidence is set down under the three following headings: (a) The closeness of the clinical analogy to experimental anaphylaxis; (b) the reasonableness of a protein antigen to play the part of sensitizer and intoxicant under anaphylactic conditions; (c) the possibility of demon-

strating in the blood antibodies lytic to the suspected protein or in the tissue a specific reactivity.

Certainly, Smith presents a strong array of facts justifying his conclusion of the infectious origin of vagotonia. When we go further and apply this theory to hyperthyroidism and consider that the beginning may be in a parasympathetic hyperirritability, due to a toxin, we find others more or less of the same opinion. As common a disease as tuberculosis is generally recognized to be in large part an anaphylactic disease. Vagotonic phenomena are a prominent feature in the clinical picture. The resemblance of the toxic types of tuberculosis to hyperthyroidism is strongly emphasized by many authorities who note with what great difficulty the differential diagnosis of one from the other may be made. Crile is authority for the statement that, excepting the lesion itself, the postmortem findings in tuberculosis are indistinguishable from those of Graves's disease, and in spite of opinions to the contrary, as preëminent an authority as Pottinger supports the toxemic theory, as the following quotation shows: "I realize that scientific opinion of today is toward the theories that insufficient iodine being obtained by the individual and that of infection being the causative factors in the enlargement of the thyroid gland, but I cannot help but think that a hyperplasia of the gland takes place in the presence of toxemia while no infection of the gland itself occurs." He believes that the hyperirritability in the autonomic system is attributable to thyroid sensitization, the thyroid hypersecretion in turn by increased adrenin in the blood. We believe the evidence is against thyroid sensitization of the vagal fibers in the system and against the adrenal hyperactivity under such conditions.

Clinicians who have followed the work of Lane and his school cannot help but be impressed with the part played in the etiology of hyperthyroidism by material from the large gut. McGarrison's work in this connection is of extraordinary interest. Not uncommonly the teeth, the tonsils and the accessory sinuses have been established as the determining factor, and while admitting the possibility of reflex irritation through the nerve trunks to either the cervical sympathetic or the gland itself, one leans rather to the belief that the chronic infection is the cause. From the foregoing discussion it seems reasonable to conclude that infection, in a great many instances, may be the determining factor in the development of hyperthyroidism, and that many cases of neurocirculatory asthenia have an analogous pathogenesis.

And now let us consider the part the thyroid plays. We know that thyroid secretion follows upon the discharge of adrenin into the blood. This seems firmly established by the work of Cannon. It therefore is active in fright, fear and like sudden emotional states, but that it is transitory and passing with the emergency, when so induced, seems likely, as is the case with adrenin the activator.

Another cause that would seem established is that of primary stimulation in disease of the cervical sympathetic as described by Wilson and Durant. But both causes are operable only in a small group of cases in the syndrome, and we believe there is still a large unexplored field to be worked in establishing the etiology in the disease. Hence, the following facts about a factor we believe of considerable importance.

Barr maintained that the syndrome occurring among the troops in France, which he believed to be hyperthyroidism, was due to a vicious circle in which the deficiency of calcium in the blood was a contributory cause in the production of the hyperthyroidism and the excessive action of the thyroid the cause of a greater calcium metabolism. When we consider that the minimum of calcium per day required for the normal human nutrition is 0.45 gram, and that in the absence of milk from the dietary pounds of meat or common milled cereals would be required to furnish it, the conclusion is justifiable that the fighting units fail to realize their calcium need. Since the time of Besredka it has been known that calcium salts prevent the appearance of anaphylactic phenomena when toxic doses of anaphylatoxin are simultaneously given with the calcium. BurrIDGE has shown that the capacity of tissue activity to compensate inhibition is in direct ratio to its calcium contents. The assumption seems reasonable that deficiencies of calcium in the system require increased thyroid activity in order to liberate calcium from the storehouses. This seems undoubtedly true in view of the established fact that under all contingencies of diet and activity the calcium concentration of the blood is maintained at extraordinarily constant levels and that a greater need for calcium exists in the presence of diseases with which anaphylaxis is a part, this mobilization of calcium compensating inhibitory phenomena in tissue and allowing approximately normal activity.

And now we propose to indicate the relative degree of responsibility of the different factors we believe to be acting in the causation of the syndrome of soldiers' heart.

Two classes of individuals developed the syndrome: (1) the men who, after successfully passing the draft board examination, manifested the syndrome after reaching camp, a result, it would seem, of the nervous and emotional strain of ordinary military service; (2) men exposed to the rigors of active service who manifested the syndrome, and in a great number the onset was fairly sudden, developing in men who had carried on in perfect fettle, in some instances for as long as two or three years before breaking down. Two deductions seem justifiable from these facts that in the individual of potential autonomic instability (neurocirculatory asthenia) the nervous and emotional strain of military service will probably promptly precipitate a syndrome, and that in a normal man factors other than the strain of service are necessary to develop the potentiality.

As an explanation of the manner in which emotional stress and strain act as a cause in the syndrome we have the work of Cannon. He demonstrated in the animal adrenin mobilization in considerable amounts in such states, and it has long been accepted that adrenin acts upon the autonomic nerve structures. We agree that adrenin effect probably explains in part the sensitization of this system in the soldier. But that it is the single factor concerned we somewhat doubt. It would seem probable that profound inhibition in states of fear in the soldier combine with adrenin effect in sensitizing the autonomic system. The training toward and realization of perfect discipline in the soldier is in great part to establish the ascendancy of inhibition from the higher centers over just such primary impulses as those with which adrenin mobilization is concerned.

It would seem probable then that the common state of men in active combatant areas was one of fear, in which the autonomic nervous system was subjected to showers of adrenin and at the same moment profound inhibitory impulses from the brain. An illustration of this may be drawn in that of a spirited horse that at the same moment is locked into inaction by strapping or a tight rein and is cut deeply with a whip.

Another phase in the problem concerned with the understanding of the pathogenesis of functional disease in the soldier, which we believe had been too little considered, is the disturbance of tissue chemistry which we may discuss in terms of calcium metabolism. Gaskell and Elliott, after destruction and degeneration of the nerves of the vegetative system to a part, have demonstrated, after six weeks, full adrenin effect on the part. This would seem to establish adrenin action as directly on the tissue and independent of the vegetative system itself.

Burridge establishes from his experiments that the action of adrenin is to make the tissue independent of its media, particularly the calcium concentration in the perfusing media. Maximum heart work was maintained on a perfusing solution containing one-twelfth the required calcium content when adrenin was added to the solution.

These facts would suggest that individuals living for any time under conditions, such as emotional stress, which tended to a maintenance of relatively high amounts of adrenin in the blood would very soon have an unbalanced tissue chemistry. These facts would explain how the soldier on an abnormally low calcium diet would appear to maintain a calcium equilibrium, and only with the development of sudden call for more calcium, as in acute disease, would we expect manifestations of deficiency.

We believe, therefore, that there is considerable ground for the opinion that some of the phenomena of disease among soldiers, notably the bone pains, tremors thought to be cerebral in origin and

general exaggerated response to normal stimuli are an expression of the disorganization of the inorganic chemistry.

However much there is a disagreement on the mechanism of the forces acting in the production of the syndrome neurocirculatory asthenia in what we may call the potential individual at the present moment, we are more concerned with the factors which result in the potentiality, because in our case of the civilian we must be prepared to recognize in its incipient and mild types what has undoubtedly been a very common condition classified under varieties of neurosis, and we believe infections to be the predominant factor in causation of the potentiality. This is the point we wish particularly to emphasize in this paper and consider the other points of interest here only in so far as they support this belief.

CONCLUSIONS. 1. That some types of hyperthyroidism are analogous to the entity neurocirculatory asthenia and their pathogenesis is probably identical, the phenomena being attributable to a hyperexcitability of the opposing sets of fibers of the autonomic nervous system.

2. That in both conditions the syndrome develops in individuals in whom there is a hyperirritability of one or other sets of fibers in the autonomic system. Hence, constitutional predisposition due to inherited sympathetic or vagotonic instability is a factor in the causation on a sound basis.

3. That nervous and emotional strain is the immediate cause, precipitating the syndrome in susceptible individuals.

4. That in the cause of susceptibility (acquired instability of the autonomic nervous system) infection plays a predominant role and the susceptibility in such cases may be accepted as indicating a chronicity of the infection with constant or frequent outpourings into the blood of the infective agent.

5. That there is a certain rationale for believing that this instability in the autonomic nervous system lies in the element of anaphylaxis in disease in the predilection of anaphylatoxin for the parasympathetic system.

6. That there is some evidence that deficiencies of calcium in the diet may have played a part in the causation of some of the phenomena and that the higher plane of inorganic metabolism in the organism may have shared with adrenin increase the responsibility in causation of the thyroid hyperplasia and hyperthyroidism among the soldiers.

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THE RELATION OF THE BACILLUS INFLUENZA TO THE RECENT EPIDEMIC.

BY GUTHRIE McCONNELL, M.D., MAJOR, M. C., U. S. A.,
CHIEF OF THE LABORATORY, CAMP DEVENS, MASS.

As an indication of the comparative suddenness of this epidemic, it may be noted that in the index number of the *Journal of the American Medical Association*, June 29, 1918, which includes the preceding six months, there are but three references to influenza. During the following six months the index number of the same journal shows over 175. Yet in spite of the many articles on the subject, there still remain certain unanswered questions. One of these undetermined points is the source of the epidemic, another refers to the date of its inception, a third as to the etiological factor.

Naturally, no country is particularly anxious to admit that it was the originator of the outbreak, any more than in the past was there any desire to claim paternity for syphilis, which in France was known as the Italian disease, while in Italy it was accredited to France. Although the present infection has been known popularly as the "Spanish Flu," there is really very little incriminating evidence.

It seems that during the early spring, and also in the autumn of 1917, scattered cases of influenza were reported from as widely separated areas as England, France, Vienna and lower Austria. At no time did it reach epidemic proportions, yet the evidence indicates that the potential possibilities were present. During the winter of 1917 and 1918 there does not seem to have been any noticeable increase. In the middle of April, 1918, the reports from the A. E. F. showed, however, that a widespread outbreak had occurred of a disease whose course was characterized by a sudden onset, high fever, headache and backache, lasting three to five days, and leaving in most instances a profound weakness. This epidemic was of unusual mildness and disappeared largely by the end of July.

During the same period a similar outbreak took place in Spain, following the same course in regard to mildness and duration. The Spanish physicians state that the medical profession in Paris had reported cases of influenza there several weeks before it made its appearance in Spain. On turning to reports from Germany it becomes evident that that country was having its own difficulties so far as influenza was concerned, as during the spring of 1918 it was suffering from a widespread infection.

To add to the difficulty of the situation a visitation of influenza made its appearance in Manila, in the Philippine Islands, in June, 1918. Coutant¹ reports that at the same time 30 to 40 cases occurred on a United States transport which left San Francisco shortly before the epidemic appeared in Manila and arrived after the epidemic was over. Reports come also from London that the epidemic there was widespread in June.

From the United States Navy Base Hospital No. 2, in France comes the information that on July 16, 1918, nineteen Hindus, from a single vessel, and who had just become ill with influenza, were admitted to the hospital. There had been a few cases previously at the Base, but beginning with the above a distinct epidemic occurred. The place from which the Hindus came was not stated. About this same time, July 15, 1918, comes the report from Havana that during the preceding months one-fourth of the population was taken ill by an epidemic of a disease similar to the grip. It presented the same symptoms as occurred in the Spanish outbreak, and was thought probably to have been carried to Cuba by Spanish vessels.

Chelsea, Mass., reports that during the two weeks from August 28, 1918, to September 11, 1918, a severe and rapidly spreading epidemic of influenza appeared. This developed within one or two days after the arrival from the receiving ship of the first group of some fifty patients. The disease was carried to Boston probably by patients and by carriers. On September 9, 1918, the disease first appeared at the Great Lakes Receiving Station. From that time on first one city or camp was attacked and then others in rapid succession, until the entire country was overwhelmed.

During these months, reports were coming from all parts of the world to the effect that the epidemic had made its appearance. In August, Peru was being swept by the plague. In October, Mexico City reported the epidemic. The South Sea Islands were attacked, as were parts of Alaska and of Jamaica; no area seemed to be immune. It apparently made no difference whether the countries were hot or cold, wet or dry, high or low, the visitation showed no partiality.

During the spring the disease seemed to be quite mild, lasting but a few days, with slight mortality, and there was but little suggestion of what was to come. But when the recrudescence took place

¹ Jour. Am. Med. Assn., November 9, 1918

there was a sudden and unexpected change. It was no longer a mild and innocuous affair, as at first, but became an appalling scourge. From the latter part of September, for the next two months, practically the entire world was swept by the outburst. Why there should have been such an increase in virulence may possibly be explained on the basis of an increase due to the transmission of the organism from one individual to another until a very high degree of virulence had been acquired. During the summer months, when the community spends a greater part of its time out of doors, the chances of infection are less; during this time, however, scattered cases were constantly occurring. As soon, however, as any crowding took place the contagion spread and the organisms having become more virulent, gave rise to a more serious infection.

The greater part of the evidence would indicate that the influenza epidemic had its origin in Europe, but in just what section it is impossible to state. From there it came to the eastern part of the United States and rapidly extended. There remains one feature that is difficult to explain, how it was that there was an outbreak in Manila, and at the same time a transport arrives from San Francisco with 30 to 40 cases on board. These outbreaks arising somewhat before the disease seems to have gained entrance to the eastern United States. So far as the epidemic in Manila is concerned it might have resulted from an extension of the disease from China. In fact, one of the explanations of the origin of the epidemic in western Europe was that it might have been carried by Chinese coolies who were brought into areas close behind the front.

During the first outbreak it was noticed that the great majority of the patients attacked were in the prime of life, anywhere from twenty-five to thirty-five years of age. The two extremes, childhood and old age, which are usually the ones to suffer when respiratory infections occur, were not at first involved to any extent. It was not until the second wave in this country had made its appearance that the extremes in age were attacked.

ETIOLOGY. When the epidemic made its appearance the general opinion held was that influenza had once more occurred as a pandemic—that we were dealing with a clinical condition resulting from infection by the bacillus of Pfeiffer. As reports of bacteriological examinations began to come in the opinion was that the *Bacillus influenza* was the causative agent. Very soon, however, more and more doubt was entertained as to its importance. The results were most confusing and conflicting.

Krumbhaar² reports finding in 75 per cent. of his cases a bacillus identified with that of Pfeiffer. Keegan³ states that the results of cultures taken directly from the lungs show that the *Bacillus*

² Jour. Am. Med. Assn., November 9, 1918, p. 1573.

³ Ibid., September 28, 1918.

influenza occurred either in pure or mixed cultures in 82.6 per cent. of the 23 cases studied. M. J. Rosenau⁴ obtained it in 83 per cent. of his first 26 autopsies. Tunncliffe⁵ isolated it in 58 per cent. of sputum cultures made in the first or second days of the disease. In the report of the influenza epidemic in the British Armies in France⁶ it is stated that the Pfeiffer bacillus was recovered in 91 instances from a series of 220 specimens of sputum, 60 times from 164 specimens from the nasopharynx and twice in the blood from 68 cultures. Gotch and Wittingham⁷ in 50 cases found the organism in cultures in 8 per cent. and influenza-like bacilli in smears of 62 per cent. of the cases.

Soper⁸ states that "The causative agent is generally believed to be the bacillus of Pfeiffer." Hall, Stone and Simpson⁹ in the examination of sputum and throat smear found the bacillus 58 times in 79 uncomplicated cases. Park¹⁰ says that "With our present technic we have found Pfeiffer's bacillus in almost every case of clear-cut infectious influenza." Brem, Bolling and Casper,¹¹ in reporting the epidemic at Camp Fremont, Calif., obtained 25 per cent. positive results in 148 cultures from the nasopharynx in consecutive cases. In 537 selected severe cases it was found in 46 per cent. In Germany¹² Uhlenhuth in a series of 47 cases recovered the influenza bacillus by culture in 46.8 per cent., and Bergman in 75 per cent. of twenty sputums examined. In a communication from Buenos Ayres¹³ comes the information that the bacillus was found in 60 per cent. of the sputum of cases, usually the more severe. In fatal cases it was found in 50 per cent.

Spooner, Scott, and Heath¹⁴ report important findings as made at the Base Hospital Laboratory, Camp Devens, Mass. They succeeded in isolating the *Bacillus influenza* from pneumonia sputum, pleural fluids and the nasopharynx during life, and from the heart's blood, lungs and accessory sinuses postmortem in a high percentage of cases of this disease, very frequently in pure culture. The *Bacillus influenza* occurred alone or with other organisms in 23, or 62 per cent. of 37 cases at autopsy. It was recovered also from the sputum of 104 cases, usually in connection with some type of the pneumococcus or the streptococcus. Specific agglutinins which produce satisfactory reactions on homogeneous and heterologous cultures were found in the serum of convalescents, especially during the weeks following infection. A high titer serum has been produced in rabbits

⁴ Jour. Am. Med. Assn., December 21, 1918.

⁵ Ibid., November 23, 1918.

⁶ British Med. Jour., No. 18, ii, 205.

⁷ Ibid., 1918, ii, 82.

⁸ Jour. Am. Med. Assn., December 7, 1918.

⁹ Ibid., December 14, 1918.

¹⁰ New York Med. Jour., 1918, cviii, 621.

¹¹ Jour. Am. Med. Assn., December 28, 1918, p. 2138.

¹² Ibid., November 9, 1918, p. 1573.

¹³ Ibid., January 4, 1919.

¹⁴ Ibid., January 19, 1919.

by repeated inoculations with living cultures. This serum has showed an increase of potency with the passage of time.

Other investigators, however, were unable to find the organism in such high percentages. Gotschlich¹⁵ obtained it in 12 per cent. of the examinations of 23 sputums, Uhlenhuth made cultural recoveries in but 13 per cent. Blanton and Irons¹⁶ in 366 cases obtained the bacillus in 8 per cent. Cummings,¹⁷ 12.4 per cent. in a series of 100. Nuzum and others¹⁸ in 8.7 per cent. in a total of 2000 cases and Strouse and Bloch¹⁹ 20 times in 273 examinations. In the German reports²⁰ Lubarsch in 14 cases found it once, Schmorl in 3 out of 50 cases in the bronchial mucus. Hirschbruch once in 15 cases and Gruber and Schadel 14 times in 250 cases.

We find other men who were not as successful as even those just mentioned. Grüber, in Munich, and Friedman, in Berlin, failed to find the influenza bacillus, and Kolle, in Frankfort, was unable to find it in any of the cases which he had thoroughly examined.²¹

In most of these instances the influenza bacillus was not found in pure culture; in the vast majority there have been other organisms in association, usually a pneumococcus or a streptococcus. Hall, Stone and Simpson²² obtained pneumococci 76 times and hemolytic streptococci 4 times out of 79 cases. Blanton and Irons (*q. v.*) in smears and throat cultures obtained hemolytic streptococci in 33 per cent., and pneumococci in 12 per cent. They also make the interesting report that 357 throat cultures taken before the epidemic began, from apparently healthy men, gave 75 per cent. of hemolytic streptococci and but 1 per cent. influenza bacilli. Strouse and Bloch (*q. v.*), although finding the *Bacillus influenza* 20 times in 273 examinations, report that streptococci, staphylococci and pneumococci predominated. Brem, Bolling and Casper (*q. v.*), as already stated, found influenza bacilli in 46 per cent. of 537 cases, but usually associated with other organisms. Keegan (*q. v.*), in cultures from more than 100 cases, found that the predominating organism was a Gram-positive diplococcus, forming a considerable green area surrounding the small gray colonies.

In an article on vaccines in influenza²³ the following sentence occurs: "The organisms most frequently associated with Pfeiffer's bacillus, and in their opinion chiefly responsible for the gravity of the secondary pulmonary complications, are pneumococci and streptococci." Tunnicliff (*q. v.*) isolated a green producing streptococcus in 87 per cent. of 110 cases of influenza and pneumonia. According to Hirsch and McKinney²⁴ the predominating organisms

¹⁵ Jour. Am. Med. Assn., November 9, 1918, p. 1573.

¹⁶ Ibid., December 14, 1918.

¹⁷ Ibid., December 21, 1918.

¹⁸ Ibid., November 9, 1918, p. 1573.

¹⁵ Ibid., November 9, 1918.

²⁰ Ibid., November 9, 1918, p. 1573.

²¹ Ibid., November 19, 1918 (quoted from Nuzum).

²² Ibid., December 14, 1918.

²³ British Med. Jour., October 26, 1918, p. 470.

²⁴ Jour. Am. Med. Assn., November 23, 1918.

in the epidemic of bronchopneumonia at Camp Grant were Gram-positive cocci, usually diplococci. In 200 postmortems the cultures showed Gram-positive, lancet-shaped diplococci. In all the throat cultures the occurrence of the influenza bacillus was only occasional and never in pure culture. The *British Medical Journal*, November 16, 1918, states that, "The influenza bacillus, the pneumococcus, and above all in this epidemic the streptococcus, seem to be responsible for most of the fatal complications of influenza." Nuzum and others (*q. v.*), in their 2000 cases found pneumococci to be the predominating organisms in the sputum, in throat cultures and in the lung cultures, both during life and at necropsy. Pneumococci of unusual virulence were the most important early secondary invaders. Glaus and Fritschie²⁵ in 53 autopsies found the fatal complications of influenza to be due to a mixed infection with pneumococci, streptococci and staphylococci. No influenza bacilli were found.

Various reports from other sources agree with those given above. Bie²⁶ and others report from Copenhagen that sputum collected from influenza patients immediately on entrance into the hospitals showed invariably numerous pneumococci alone or predominating. Pfeiffer's bacillus was not found. They obtained constantly Gram-positive, lanceolate diplococci, usually encapsulated even when occurring in chains. In 28 instances they were obtained in pure culture from sputum. Blanton and Irons (*q. v.*), made smears and throat cultures in 366 cases and obtained the following results: Hemolytic streptococci, 34 per cent.; non-hemolytic, 33 per cent.; pneumococci, 12 per cent.; influenza bacilli 8 per cent. Cummings²⁷ in a series of 100 specimens obtained hemolytic streptococci in 27.6 per cent., Group IV pneumococci in 90 per cent., and *Micrococcus catarrhalis* in 20 per cent.

In addition to the various forms of cocci mentioned above, Ciauri²⁸ reports the cultivation from the blood and sputum of influenza cases a microorganism that appears in two forms, rods and ovals, but both stain deeply at both poles, the rods being Gram-positive, the ovals Gram-negative, but the two forms were always found in the cultures. This organism was found only in the graver cases, those which seemed to be of a septicemic type. He calls it the "bipolar diplomorphus hemoseptic bacillus." Somewhat similar organisms have been reported elsewhere, but nothing really definite concerning them has been determined.

The more closely the reports are examined the more do the indications point toward the cocci as being the dangerous invaders,

²⁵ Correspondenzblatt f. schweiz. Aerzte, Basel, September 7, 1918.

²⁶ Ugeskrift f. Laeger, Copenhagen, Jour. Am. Med. Assn., December 14, 1918.

²⁷ Ibid., December 21, 1918.

²⁸ Policlinico, Rome, Jour. Am. Med. Assn., November 16, 1918, p. 1700, and December 28, 1918, p. 2183.

those that are really responsible for the severity of the epidemic. The role played by the influenza bacillus apparently becoming less and less important. In fact, we find many men doubting its importance, Synnott and Clark²⁹ are by no means certain that the Pfeiffer bacillus is the original infecting agent. Bischer³⁰ reiterates that his findings in the prevailing epidemic point to invasion by highly virulent streptococci and that there was not the slightest evidence to prove that the influenza bacillus was the cause of the disease. Ely and others³¹ state that "Our findings failed to show that it (*Bacillus influenza*) was in any way connected with the production of the disease." Hirsch and McKinney (*q. v.*) believe that the "*Bacillus influenza* played no role in the epidemic at Camp Grant." Brem, Bolling and Casper (*q. v.*) hold that "Pfeiffer's bacillus is an incidental or secondary invader."

The question as to what is the cause of the disease remains unanswered. It seems quite evident that the dangers of the disease are due to the secondary invaders and that the relation of the *Bacillus influenza* is of little importance. As early as October 5, 1918, an editorial in the *Journal of the American Medical Association* remarks that the "Causative agent of epidemic influenza has not been certainly recognized," and that "There is much uncertainty as to its (*Bacillus influenza*) etiological role." Again, the same journal (October 12, 1918), in another editorial states that "The precise cause of the primary acute respiratory infection is not known—it may be the *Bacillus influenza*; as yet definite proof is wanting." The British Research Committee³² quotes from German sources. Obendorfer: "The primary bacteremic condition was not found due to Pfeiffer's bacillus, and thus the invading virus remains undiscovered." Bergman never found the *Bacillus Pfeiffer* in postmortem material, and states: "The real virus remains to be discovered." In an article on "The Prevention and Treatment of Influenza"³³ the following statement occurs: "Although there can be no question that the virus of influenza is a living organism and capable of transference from man to man, yet the nature of the virus is still uncertain." At the meeting of the American Public Health Association³⁴ Jordan stated that "We have in cases of pandemic influenza an infection with an unknown or unrecognized virus which increases the susceptibility of the individual." Vaughan: "I should say it (influenza) is a disease of unknown origin." Hektoen: "I think we must be dealing with a disease of unknown etiology." In the same number of the above *Journal* the following occurs in an editorial: "The discussions relative to the etiology of the present epidemic resolve

²⁹ Jour. Am. Med. Assn., November 30, 1918, 1816.

³⁰ Correspondenzblatt f. Schweiz. Aerzte, October 5, 1918.

³¹ Ibid., January 4, 1919.

³² British Med. Jour., November 16, 1918.

³³ Jour. Am. Med. Assn., December 21, 1918.

³⁴ Ibid., November 9, 1918, p. 1573.

themselves into the belief that the influenza bacillus is not the primary etiological factor and that the actual cause is unknown."

Inasmuch as such serious doubts were cast upon Pfeiffer's bacillus, various attempts were made to discover what might be the cause. It was thought by some there might be a filterable virus present, and attempts were made to produce the disease by making use of a filtrate obtained from the sputum in cases of influenza. Probably the first to report such experiments in this country was Keegan (*q. v.*), who worked in conjunction with M. J. Rosenau. Nine volunteers who had not been exposed to the disease were used. The experiment consisted of introducing the filtrate of the washings, from the nose and throat of two cases of influenza, into the anterior nares of the volunteers. The nose and throat of each patient was washed and gargled with 75 c.c. of sterile physiological salt solution. Throat swabs and sputum were added to the separately collected washings. Each was shaken with beads in a sterile bottle and filtered through a Mandler diatomaceous earth filter by means of a water vacuum pump. One filter had a positive pressure of 9 pounds and the other of 12 pounds. Cultures were made from the clear filtrates for control. About 0.5 c.c. of the filtrate was introduced into the anterior nares of each of the volunteers, five receiving the filtrate from one case and four from the other. Three and a half hours elapsed from the time of obtaining the nasal washing until the time of nasal instillation. The control cultures were negative for bacterial growth and none of the nine volunteers have shown symptoms of influenza during ten days of isolation.

In November, 1918, similar experiments were made at the Yale Army Laboratory School, New Haven, Conn., Col. C. F. Craig, M. C. in command, with negative results both as to use of the filtrate and also of the living influenza bacilli. The report of these experiments has not as yet been published.

Nicolle and Le Bailly³⁵ report several experiments on men and monkeys, in which filtered bronchial secretions of patients in the early stages of typical influenza were used. This material was injected subcutaneously and intravenously with apparently some positive results. On careful reading of the original articles it becomes evident that too much reliance should not be placed upon the results, as the experiments were few in number; they were done during the height of the epidemic upon persons who in all probability had been exposed. Also, the volunteers had not been isolated for several days before the inoculations were made. The evidence is far from conclusive.

In addition to the bacteriological findings there is still further evidence against the *Bacillus influenza* being the important causative agent. A study of the reports dealing with the clinical course of

³⁵ Compt. rend. Acad. de sc., 1918, clxvii, 607.

these causes shows that the usual blood picture is that of a leukopenia. Practically all observers agreed that such was the condition found that a leukocytosis indicated a complication, usually of pneumonia. In other words the infecting agent, whatever it might be, interfered in some manner with the formation of white cells, with a consequent leukopenia. At the Yale Army Laboratory School blood examinations were made of about 150 men who had been inoculated with influenza vaccine. These counts were made at varying periods after the inoculation. The results showed that there were no evident alterations in the blood picture. There was neither an increase nor a decrease in the number of white cells nor was there any alteration in the normal percentages of the different varieties of leukocytes. One might consider this fair evidence against the importance of the influenza bacillus as the cause of the epidemic.

Almost as soon as the cases made their appearance, treatment by means of so-called vaccines was instituted, in spite of the fact that such a method is not applicable to acute general infections. On account of the rapidity of the invasion it was necessary to make use of stock instead of autogenous vaccines. As is usually the case a number of men were quite enthusiastic, but more careful investigation indicated that it was not effective. A committee, consisting of Rosenau, Gay and McCoy was appointed in Massachusetts to consider the evidence available on the prophylactic and therapeutic use of vaccines against influenza. They presented the following conclusions:³⁶

"1. The evidence at hand affords no trustworthy basis for regarding prophylactic vaccination against influenza as of value in preventing the spread of the disease or of reducing its severity. The evidence from the present epidemic, though meager, suggests that the incidence of the disease among the vaccinated is smaller than among the non-vaccinated. The board, therefore, concludes that further experimental evidence should be collected.

"2. The evidence at hand convinces the board that the vaccines we have considered have no specific value in the treatment of influenza.

"3. There is evidence that no unfavorable results have followed the use of the vaccines."

A second committee appointed in Massachusetts and reporting at the same time, consisted of Whipple, Davis and Crum. Their report follows:

"1. The weight of such statistical evidence as we have been able to accumulate indicates that the use of the influenza vaccine which we have investigated is without therapeutic benefit.

"2. The statistical evidence, as far as it goes, indicates a probability that the use of this influenza vaccine has some prophylactic value.

³⁶ Jour. Am. Med. Assn., October 19, 1918.

The committee also reported that "the use of such a vaccine is to be regarded as experimental."

In October and November, 1918, quite a large number of officers and enlisted men at New Haven, Conn., were given repeated injections (three) of an influenza vaccine in the hope that it might prove to be of some value as a prophylactic. The results were such that the general opinion was that the vaccine had little value if any. There were numerous instances in which those who had been injected acquired the disease within a comparatively short time. Barnes³⁷ compares the results in two series of cases in one institution, one series of 152 unvaccinated persons, the other of 113 vaccinated. He found that the morbidity was only slightly lower among the vaccinated and the mortality among those who developed influenza was practically the same, whether vaccinated or unvaccinated.

The article of Spooner and others (*q. v.*), up to the time of publishing, is the most weighty bit of evidence in favor of the *Bacillus influenza* being the cause of the epidemic. The fact that they obtained well-marked agglutination in high dilution with the serum of convalescent patients is of distinct importance, as was the production of a high titer serum in rabbits inoculated with living cultures. More work along these lines would be of great value.

CONCLUSIONS. To recapitulate, it is first shown that although many observers found the *Bacillus influenza* in cultures in quite a high percentage of cases examined, there were just as many equally skilful men who found the organism in a very small number of the cases cultured or did not find it at all.

It is evident, and recognized by all, that the serious symptoms were not due to the presence of the *Bacillus influenza*, but were the result of invasion by secondary organisms, these being mainly pneumococci and streptococci.

Accompanying the disease was commonly a well-marked leukopenia, which, however, did not occur when killed cultures of influenza bacilli were injected. In a series of about 158 individuals examined after such inoculations, there was in fact no alteration from the normal blood picture. The injection of these cultures did not appear either to prevent the disease nor to ameliorate the condition after injection had occurred.

The inoculation by filtrates of sputum and bronchial secretions cannot be said to have caused the disease, nor has the infecting of the nasopharyngeal mucous membranes with recently isolated pure cultures of living influenza bacilli given rise to symptoms.

In view of the above findings it would seem that the evidence is not in favor of the *Bacillus influenza* being considered the etiological factor in the recent epidemic.

³⁷ Jour. Am. Med. Assn., December 7, 1918.

BACILLUS BOTULINUS POISONING: WITH A REPORT OF SEVEN CASES, FOUR OF WHICH PROVED FATAL.

By G. W. McCaskey, M.D.,

PROFESSOR OF MEDICINE, INDIANA UNIVERSITY SCHOOL OF MEDICINE,
FORT WAYNE, INDIANA.

FOR many years occasional outbreaks of food poisoning of a more or less serious character have been reported from time to time. These were mostly under the title of botulism or allantiasis, the exact nature of which was entirely unknown, until Van Ermen-gem, in 1895, identified and isolated the *Bacillus botulinus*. This organism apparently bears a specific relationship to the disease, although it is contended by some observers that at least some of the cases are due to other sorts of infection. It would be an exception to the general laws of epidemiology if mixed infections did not occasionally play a confusing role. I believe, however, that it may be confidently assumed that in all the cases presenting the very characteristic and typical syndrome this organism plays the principal part, and in fact causes the main symptoms by the specific action of an exogenous toxin or toxins, produced for the most part and perhaps altogether under saprophytic conditions.

Because of its direct bearing upon the clinical study of these cases the cultural and other characteristics of the organism become of first importance. It is strictly anaërobic, so that a piece of ham or vegetable, for example, just below the surface of a fluid in which it is partially immersed might be intensely toxic while the supernatant portions would be entirely innocuous. This very probably offers an explanation of many seeming paradoxes, when, for instance, of several persons partaking of the same food some are affected and others not. The original conception of the disease as the result of meal poisoning is incomplete. The designation "sausage poisoning" (*botulus*), by which it was often known, is, of course, more so. As a matter of fact the organism is found much more frequently in vegetable than in animal food, and in the outbreak about to be described was found only in canned vegetable foods, although the meat which formed a part of the meal had disappeared and could not be examined. In this connection some facts of comparative pathology must receive our attention.

In several parts of this country, at different times, outbreaks of disease among horses and cattle have occurred, known variously as forage poisoning, cerebrospinal meningitis, cerebritis, staggers, blind staggers, cornstalk disease, etc. The records immediately available especially include Kentucky, Illinois and Iowa, and very heavy losses have occurred from this disease. Prof. Robert Graham, of the Department of Animal Pathology in the University of Illinois,

has made very extensive investigations and has isolated an organism corresponding very completely with the *Bacillus botulinus*. It is morphologically and culturally identical, responds to the same agglutination tests, produces the same characteristic and fatal syndrome in animals, which can be immunized against it by the *Bacillus botulinus* antitoxin. To this may be added the fact that the pathological findings in animals killed by this organism are identical with those found in animals killed by known *Bacillus botulinus* intoxication. There would seem to be no reasonable doubt that the two organisms are identical and that this pathogenic saprophyte is very widely distributed throughout the country, producing extensive losses among domestic animals and ready at any time to produce a fatal outbreak in human subjects under favorable conditions. It is indeed quite probable that there are other causes of food poisoning even of an infectious nature, but in all cases in which the very characteristic clinical picture to be later described is found the *Bacillus botulinus* may be confidently assumed as the infecting agent. Furthermore, there are probably milder and somewhat atypical outbreaks occurring in individuals or groups less characteristic, but still due to this same organism. It is altogether likely that a very small proportion of the outbreaks of botulism have ever been recognized or recorded in this country. A very significant circumstance is found in the literature in different countries. It first attracted attention in Germany, and in the literature of continental Europe up to this time we find no less than 132 communications on the subject. Great Britain has contributed a small number and our country but little more. If the subject receives the attention that it should have, and the cases are recognized, the number of reports in this country will undoubtedly rapidly increase.

I will here introduce the clinical records of the seven cases which form the basis of this paper before discussing the general symptomatology, pathology and treatment. The clinical observations made on these cases were very incomplete, owing to the circumstances under which they were seen. The investigations were hurriedly made in an adjoining town without the assistance of a laboratory technician or clinical assistant on the spot, and hence were not as full as they otherwise would have been.

On Friday noon February 22, 1918, all of the patients, with at least three or four others who entirely escaped, partook of a meal consisting of beef and several vegetables, among which were especially remembered mangoes and canned beans.

As will be seen in the following brief outline of these cases the symptoms developed with varying rapidity on that and the following days.

Case I was seen in consultation with Drs. Boyers and Coverdale and the other patients later under the care of Drs. Smith, D. & D. Clark and Miller. I am deeply indebted to these gentlemen, and in

fact the entire medical profession of Decatur, for their cordial coöperation in the observation and study of these cases.

CASE I.—Robert K., Decatur, Ind., aged thirteen years, white. Was seen February 26, 1918, died February 28, 1918. Was taken ill February 23, the day following ingestion of the meal, with headache and vertigo. The following morning, on arising he still complained of vertigo and vomited. Vomiting repeated three or four times during the day. It is not thought that he had any fever on February 24; in fact, vomiting and vertigo were the only symptoms on that day. Dr. Coverdale was called on the evening of February 25 and found a temperature of 99.5°.

On this day, February 25, there were no symptoms except dysphonia and dysphagia.

February 26. Temperature, 99.5°. Is unable to swallow fluids this afternoon; they are not regurgitated through the nose, but simply are retained in the mouth and rejected. Voice has a nasal twang and throat appears obstructed. Has some stomach pain. Pulse, 120. White blood cells, 7800; polynuclears, 78 per cent.; small lymphocytes, 13; large lymphocytes, 9.

Throat smear shows a few large epithelial cells, some streptococci and occasional other non-specific organisms. Cultures yielded streptococci and staphylococci.

Not autopsied.

CASE II.—Mrs. R., Decatur, Ind., aged thirty-seven years, white. Seen February 27, 1918. White blood corpuscles, 13,000; polynuclears, 80 per cent.

Taken ill on Saturday with vomiting. Dysphagia on Sunday. Ate roast beef, other things unknown. About six hours after the noon meal she began to feel nauseated. Friday night she had vomiting and abdominal cramps; the next morning she continued vomiting, which was more severe, and her tongue became stiff. The following day she had ptosis of the eyelids; aphonia and aphagia not marked; slightly drowsy; pain in head; back of eyes "head full." Aphagia complete by Monday evening. Aphonia complete by Wednesday night. Bowels constipated. Temperature always normal or subnormal. Pulse normal until Thursday A.M.; 116 to 120 since. Gets "sinking spells;" is pale; pulse "disappears." Diplopia early and transient. Ophthalmoscopic examination entirely negative. Pupillary reflexes abolished; mydriasis. Medication: cathartics and strychnin merely incidental. Botulinus antitoxin, 5 c.c., subpectorally on March 2, 1918, 8.30 P.M. Patient died a few hours later.

CASE III —Mr. P., aged forty-one years. February 22, 1918, died February 26. Meal eaten Friday noon, February 22. Late Friday evening was taken sick with epigastric pain, vomiting and diarrhea. Seen by Dr. Clark on Saturday at 3 P.M.

Sunday was stuporous.

Monday morning paralysis of palate and faucial pillars, with slight ptosis of eyelids, slight mydriasis, aphagia, aphonia, and had had no bowel movement since Friday evening.

Tuesday morning, slightly icteric conjunctivæ; complete mydriasis; pulse, 120, sleepy; no pain or distress. Ophthalmoscopic examination negative; mentally clear; pulse rapid and weak. No rise in temperature at any time. Pallor throughout illness. Salivary secretions not marked. Respiratory embarrassment all day. At 6 P.M. he died suddenly. It is not known absolutely whether or not he ate of the meat.

CASE IV.—Miss B., Decatur, Ind., waitress, aged nineteen years. Ate beef heart and vegetables. Saturday vomited once or twice; bowels constipated; later had difficulty in swallowing; dysphagia; tightness in throat. Could protrude tongue half-way on Monday, but not at all on Tuesday. Ptosis complete; could not see without raising lids with fingers. Was able to wait on table Sunday evening.

First seen by Dr. Smith on Monday; ptosis of left eyelid and slight ptosis of right; slight mydriasis; aphonia; aphagia; diplopia; pulse, 78; temperature normal or slightly subnormal; drowsy; vertigo. Wednesday, swallowing improved.

Thursday, generally worse, also respiratory embarrassment; precordial pain; pulse, 130; respiration, 32.

Wednesday and Thursday, extreme and complete mydriasis. Mentality clear at all times. Died 9.30 P.M. on Thursday. Not autopsied.

CASE V.—Mrs. R., Decatur, Ind. Ate beef and vegetables on Friday. Within twenty-four hours the usual syndrome of vomiting, dysphagia, dysphonia, mydriasis and diplopia developed. The symptoms grew progressively worse, with extreme prostration. I saw her on March 3: throat was paralyzed; could only swallow with difficulty and had fetid breath. Deglutition had become gradually worse; that morning was able to take a half-ounce of tea, but nothing else. Dysphonia. Had a great deal of mucus in the throat, but was so "awfully weak" that she could not spit it up. Ptosis of left eyelid.

A few days later her physician reported that the patient was improving. Ptosis had disappeared and she was able to swallow liquids to some extent. Temperature and pulse normal. Had been taking 1 c.c. of serum every three hours. The larger doses seemed to disagree.

March 26, 1918, her physician reported patient practically recovered; ptosis, dysphagia and dysphonia entirely gone and general strength very good.

Blood findings: March 4: White blood cells, 14,000; polynuclears, 76 per cent.; small lymphocytes, 14; large lymphocytes, 4; transitionals, 4; basophiles, 2.

CASE VI.—Mrs. P., aged forty-three years. February 27, 1918. Ate beef and vegetables for dinner and eggs for supper; vomited after supper. Vomited Saturday, the following day; noticed numbness and could swallow liquids only; this increased until Monday, when she could not swallow at all. Slight ptosis and slight mydriasis Monday. As the result of catharsis, she passed some stool each day. Had vertigo at first. Later diplopic. Able to swallow liquids the ensuing Friday and Saturday.

The following report was received from her physician, March 7, 1918:

"Beginning with the following morning at 9.30, this patient was given 2 minims of the serum; there being no reaction she was given 5 c.c. in thirty minutes more; 5 to 10 c.c. doses of the serum were repeated at eight- to ten-hour intervals; 3 ounce doses of olive oil were given and serum continued in 10 c.c. doses daily for five days, during which time the patient gradually improved generally. Condition of bowels resumed normal or nearly normal functions, and by the end of the fifth day the most important symptoms had disappeared and the patient was decidedly better."

CASE VII.—Mr. L. Ate beef heart only. Bowels not constipated; left vocal cord paralyzed. Later came to hospital. Two days after meal he began to have regurgitation of fluids through the nose as the very first symptom. Four days after the meal he said his eyelids were heavy, not closed, but definite diplopia. Could not expectorate. Saw him at hospital two or three times. While at hospital he slowly improved. Had slight dysphagia and diplopia, which gradually disappeared. No serum administered.

PATHOLOGY. The pathology of botulinus intoxication presents some very striking and altogether characteristic features. Thanks to the labors of Van Ermengem, Gaffky, and more recently Prof. Graham, the main facts have been completely elucidated and a clear picture of the pathology can now be formulated. The organism itself is a spore-forming, non-motile, anaërobic bacillus, 5 to 9 μ long.

It grows best in the presence of glucose and requires a medium that is either neutral or slightly alkaline. An excess of salt and light is unfavorable for its growth.

The photomicrograph (Fig. 1) which illustrates its morphology was made by Prof. Graham from cultures of the organism obtained from ensilage. The biological characteristics of the organism have a very important bearing on its pathogenesis and the prophylaxis of botulism.

The optimum temperature for its growth is 25° to 35° C. It apparently will grow at body temperature, but becomes very much attenuated, with consequent loss of virulence, and spore formation disappears. It is killed at 85° C. for fifteen minutes.

In this connection it should be mentioned that the toxins of this organism, which are exogenous in character, as well as the bacteria

itself, are destroyed by boiling, a fact which has an obvious bearing upon the prophylaxis of botulism.

The resistance of the organism under favoring conditions is shown by the fact that the spores are viable after being kept one year in hermetically sealed tubes protected from light. Toxins obtained from the filtrates made from the cultures of this organism freed from the bacilli by passing through a Berkefeld or other similar filter have been carefully studied by Prof. Graham and others.

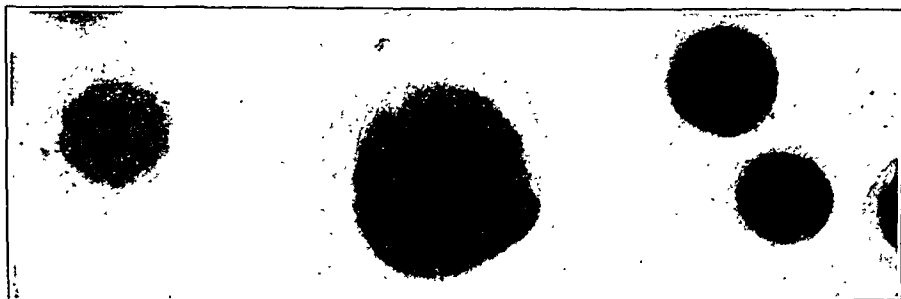


FIG. 1.—The colonies on glucose agar showing areas of liquefaction surrounding each colony.

The most important symptoms experimentally and clinically are of a neuroparalytic character.

In small quadrupeds—such as mice, guinea-pigs, etc.—paralysis of the hind legs is an early manifestation.



FIG. 2.—Prophylactic value of botulinus antitoxin. Six pigs in the rear, after being given lethal doses of toxin by mouth, received varying doses of antitoxic sera. The two controls in the foreground received a similar amount of toxin orally without antitoxin. Photograph thirty hours following the administration of toxin.

There is a striking difference in the susceptibility of different animals to the toxin. Cats, for instance, can eat large quantities of the culture without serious symptoms, while mice and guinea-pigs if given a piece of bread with one or two drops of the culture are paralyzed and die in twenty-four to thirty-six hours. The

question as to whether the principal effect is exerted upon the central or peripheral nerve elements appears to be yet undecided.

As above stated the clinical picture appears to me to be that of peripheral paralysis, but, on the other hand, there have been found definite histological changes in the central nerve elements consisting of disappearance of the chromatophile granules and formation of vacuoles, with ultimate disintegration of the nerve cells.

These changes have been especially found in the region of the third and fourth ventricles, which possibly accounts for the involvement of the vagus, hypoglossus and glossopharyngeal nerves. Even if death follows quickly there is found, in addition to the neuropathic changes blood extravasations and alterations in liver, spleen and kidneys.

If death is delayed, hyperemia, necrosis or advanced fatty degeneration may be found.

In poison by mouth severe gastro-intestinal lesions are found showing softening of intestinal coats, with hemorrhagic areas and severe alterations in some other organs.

It is interesting to note that subdural inoculation of the toxin does not produce more rapid results than when taken by mouth. This is in contradistinction to the effect of tetanus toxin.

The mydriasis which is so characteristic a feature of the clinical picture is not increased by the instillation of the toxin directly into the eye.

SYMPTOMATOLOGY. The clinical picture as elucidated by careful study of my cases, and this corresponds very closely with the symptoms reported by others, is as follows:

In 6 out of 7 cases the first symptoms were nausea and vomiting, with marked general prostration. These symptoms occurred in from six to thirty-six hours, and may be regarded as an expression of the initial constitutional effect of the toxins upon circulation, the nervous system, glandular organs, etc. The time incidence of these symptoms is generally earlier the more intense the intoxication. This was true in all with the exception of one fatal case, in which these symptoms did not appear until after a lapse of thirty-six hours. In one mild case they did not occur at all. The next group of symptoms consisted of disturbances of deglutition and phonation occurring usually in this order or simultaneously. They are due, of course, to the selective action of the toxin upon either the nerve fibers concerned in these functions or the centers from which they arise. They certainly bear a close resemblance to diphtheritic paralyses, which are known to be a result of the fixation of the diphtheritic toxin in the peripheral nerves. Pathological studies in fatal botulinus poisoning seem to have demonstrated changes in the ganglionic cells of the central nervous system, but the clinical picture is certainly that of a peripheral lesion.

The disturbances of deglutition varied from mild dysphagia to

aphagia. In some cases there was simply an inability of the patient to swallow the food, while in others fluids were regurgitated through the nose. In one case, the mildest of the group, the very first symptom which attracted the attention of the patient was regurgitation of the fluid through the nose on attempted deglutition, and this did not occur until fifty-four hours after the ingestion of the poisoned food. In this case the constitutional symptoms were apparently so slight as to escape the attention of the patient, local paralysis being the very first thing to appear. The patient apparently felt perfectly well and sat down to the evening meal, taking a drink of fluid which escaped through his nose on to the table.

Next in order come the disturbances of the ocular apparatus, both intrinsic and extrinsic. Diplopia, amblyopia, ptosis and mydriasis were practically constant in all the cases. The amblyopia in some of the cases progressed to nearly complete blindness, the pathological groundwork of which was not revealed by the ophthalmoscopic picture, this being normal in every case which was examined by myself and an oculist, Dr. Miller, of Decatur. The mydriasis was extreme and was probably a quite early manifestation. The diplopia was very constant in some of the milder cases, and persisted for a long time. The ptosis was one of the most conspicuous symptoms. It was very complete in most of the cases, it being necessary to either mechanically elevate the lids or tilt the head far back in order that the patient could look directly forward. The ptosis was undoubtedly associated with a certain degree of motor weakness of the seventh nerve, causing a very marked immobilization of all the facial muscles and giving to the patient a very striking mask-like expression.

In some of the fatal cases occurring quite late there were severe attacks of transient weakness, probably syncopal in character, which indicate an involvement of the cardiac nerve similar to that occurring in the nerve of deglutition, etc. This is rendered plausible by the fact that there was not a corresponding debility of the general muscular apparatus, some of the patients being able to sit up almost up to the time of death.

Another very striking symptom which has been dwelt on by other writers was the paralysis, more or less complete, of the intestinal musculature. The constipation was severe and there was notable absence of any indication of active peristalsis. In one of the cases closely observed by Dr. Smith, of Decatur, active borborygmus appeared as one of the first signs of improvement following the administration of the serum.

TREATMENT. As in most infectious diseases the treatment must be either general or specific in character. In regard to the former, perhaps the only thing needing special emphasis is the importance of active catharsis. It should be a general rule in all suspicious cases of food poisoning to clear out the intestinal tract as quickly and as

thoroughly as possible. This would be a safe if not an imperative rule in any form of food poisoning. This probably would be a rather easy matter if cathartics were early and vigorously administered before intestinal paralysis supervened. It would seem quite probable that some fatal cases might thus be converted into very mild ones. Both the bacteria and the toxins usually linger long, and in largest quantities if not throughout the progress of the case in the intestinal tract, the contents of which should be swept out as early and completely as possible. There is one fact developed in the experimental work, of the utmost importance in these cases, which is that fatty substances apparently combine with the toxin, markedly attenuating if not destroying its virulence. A cathartic oil is therefore the logical remedy, and full doses of castor oil or something of a similar character should be given early and repeatedly.

In regard to the specific treatment the evidence appears somewhat conflicting up to this time. When I saw the first case and recognized its character after the loss of twenty-four hours of time I found myself without any accessible information on this question. By dint of vigorous telegraphing, and finally through the medium of the Bureau of Animal Industry in Washington, I was referred to the University of Illinois, where experimental work had been done in the production of an antitoxin, which happened at that time to be ready for a clinical test, but such a test had not as yet been made. Prof. Robert Graham immediately started for Fort Wayne, Indiana, with an ample supply of antitoxin, which was finally available after about two or three days of waiting. Three of the patients were dead when we reached Decatur with the serum and the fourth died a few hours later. This last patient was given 5 c.c. after making the anaphylactic test, which was repeated a few hours later. It was obviously useless, but the patient had been anxiously waiting for it, and we felt that we could do no less than give it.

Out of the remaining three cases one (Case VII) was extremely mild and was strongly prejudiced against the use of a serum. I told him that I thought he would recover without it but that the experimental ground for its use seemed to me perfectly valid. He declined the serum and made a slow recovery.

Two of the three patients who finally recovered were treated by the antitoxin. One of these was under the care of Dr. Smith, of Decatur. On the morning of March 2 (details given above in Case VI), after the anaphylactic test, with 2 minims, this patient was given 5 c.c. of the antitoxin and at intervals of several hours during the same day two additional doses of 5 c.c. and one of 8.5 c.c. On March 3 she received two doses of 10 c.c. each, the same on March 4, three doses on March 5 and one dose on March 6, when the antitoxin was stopped. I did not see this patient after the antitoxin treatment was begun, but there seems to be no doubt that her

condition, which had been about stationary for several days, began to improve after forty-eight hours of treatment. The ptosis and mydriasis disappeared, deglutition became normal, intestinal peristalsis was restored, with free action of the bowels and expulsion of large quantities of flatus. The general condition of the patient rapidly improved and convalescence was uneventful.

Case V was again seen by me on March 3 in consultation with her attending physician, nine days after the ingestion of the poisoned food. Her condition at that time was apparently desperate, and it seemed to me that she would certainly die. There was complete ptosis and extreme mydriasis and diplopia. There was no light reaction of the pupils. There was practically complete aphagia. The patient was lying at the edge of the bed to allow the oral secretions to run from her mouth. She could not swallow them and they had to be occasionally removed from the throat by a swab. The pulse was frequent, about 115; there was complete obstipation; the patient could scarcely talk at all, the voice having the characteristic intonation of diphtheritic faucial paralysis. The prostration was extreme; a more pitiable clinical picture and one withal more apparently desperate it has rarely been my fortune to see. As above stated, I made the anaphylactic test with 2 minims of the antitoxin, and a half-hour later gave her 5 c.c. of the antitoxin intravenously, which was to be repeated every three or four hours. After giving two or three doses her physician became alarmed because of the reaction, which consisted mainly of increased pulse frequency and general prostration, and reduced the dose to 1 c.c. every three hours, which was kept up night and day for several days.

Three days after beginning the antitoxin treatment her physician telephoned me that the improvement had been very marked. The ptosis had disappeared and the patient could swallow liquids to some extent. - From this time on improvement was continuous, and on March 26 she was reported to be practically well. She visited my office a month later, apparently in perfect health.

It was very unfortunate that the antitoxin treatment could not have been instituted very early, as this is, of course, the only logical time to prevent the serious paralyses which result from the specific action of the toxin, which the antitoxin has been shown experimentally to be capable of neutralizing. The only thing that could be expected of antitoxin given at so late a time would be to render innocuous the toxins circulating in the blood at that time as well as any additional toxins which might be poured into the blood from any existing reservoir or foci. Such a reservoir, I think, undoubtedly is found in the contents of the large intestine, where the bacilli have been repeatedly demonstrated. They are growing there under saprophytic conditions and very probably continually producing toxins which may be absorbed into the circulation. In fact, these

toxins have been experimentally demonstrated in the large bowel by animal inoculation of filtrates of intestinal contents. Such benefit as was derived from the antitoxin in Cases V and VI was undoubtedly due to the fixation of toxin derived from this source, and especially in Case VI, it certainly looks as though the scale were turned in the patient's favor by neutralization of the toxins, which in all probability were being constantly absorbed from the intestinal tract. Up to the time of commencing the antitoxin treatment this patient was growing worse, and the clinical evidence is very strong that the improvement which promptly followed was the direct result of the treatment.

A review of all the facts concerning botulinus poisoning seems to support the conclusion that the organism is of very widespread distribution and that any community may at any time have such a visitation as that recorded in this paper. These outbreaks are undoubtedly quite rare, but are probably much more frequent than has been supposed. Furthermore, the experimental and clinical evidence as to the efficacy of the antitoxin in destroying the toxin is sufficiently strong to warrant its use, especially in view of the fact that there is no other treatment worth while. There are two obstacles in the way of prompt treatment at the time when it can do the most good. One of these is the difficulty of early recognition and the other having the antitoxin accessible for use without much delay.

It seems to me that the only practical method of having this antitoxin available would be through coöperation in some way with the Bureau of Animal Industry or some other department of the United States Government.

These outbreaks are so few in number and so far removed from each other that it is very doubtful if antitoxin can ever be furnished commercially.

If a constant supply of this serum could be kept at suitable stations in different parts of the country and used early in cases of suspicious food poisoning, without waiting for confirmation of the diagnosis by animal experimentation or identification of the bacillus, it should be entirely possible to prevent such tragedies as the one here recorded.

I am indebted to Dr. M. F. Porter, Jr., and Dr. B. M. Edlavitch for their assistance in this work.

A REVIEW OF THE EPIDEMIC OF INFLUENZA AT THE BASE HOSPITAL, CAMP BEAUREGARD, LA., WITH SPECIAL REFERENCE TO SYMPTOMS AND SEQUELÆ.

By DONALD J. FRICK, M.D., MAJOR, M.C., U.S.A.,
LOS ANGELES, CALIFORNIA.

THE epidemic began September 21. Cases began to be sent in to the hospital on September 24.

TABLE I.

	Numbers.	Cases of influenza.	Died.
Troops stationed here	15,000	7500	427
Personnel of Base Hospital	610	327	4
Nurses in hospital	300	152	2
Soldiers in 5th Infantry	3,200	2600	125

This table gives some idea of the way the Camp, as a whole, and different organizations were affected. The Fifth Infantry was more severely attacked as the epidemic first appeared there, and the disease was most virulent in the beginning. Of the command approximately 50 per cent. had the disease. Of the 7500 cases of influenza, 1474 developed pneumonia, or 19.6 per cent. Of these 1474 cases of pneumonia, 427 died, a mortality of 29 per cent.

We have placed the period of the epidemic from September 24 to October 18, 1918, as since the latter date admissions have been normal. A good many of the complications and sequelæ here recited have stretched over a longer period.

Charts I and II give salient features of the epidemic. Chart I shows the patients in hospital day by day and Chart II the daily admissions, including pneumonias in hospital as reported (not as they appeared) and deaths day by day.

THE DISEASE. A special report is made in the paper by Capt. McClelland on the bacteriology of the cases of influenza and the pneumonia cases following the influenza. On the day that the first case appeared in the hospital we realized the enormous amount of work that would be thrown on the laboratory staff by such an epidemic, so the commanding officer asked the laboratory men of the different organizations mobilizing here to come into the laboratory and immediately take up the task with Capt. Henderson, of working out the etiological factor of the epidemic. Their work has been of wonderful value and satisfaction to us all.

As is shown in their report the etiological factor was the influenza bacillus and the disease a true influenza.

The symptoms were of exceeding variety as to severity and kind. Most of the cases had severe backache, headache, a racking cough, flushed face, injected eyes, and, as a rule, a pulse between 80 and 100, with a temperature from 101° to 104°. Most all of them were dull and apathetic, went to sleep in the ambulance, slept on the litter while they were being carried into the hospital and had to be

aroused to answer questions. They only roused up to cough, take medicine or nourishment. They all looked prostrated and sick. All slept twelve hours, some sixteen to twenty-four hours. The fever and prostration in the mild cases lasted forty-eight hours, the

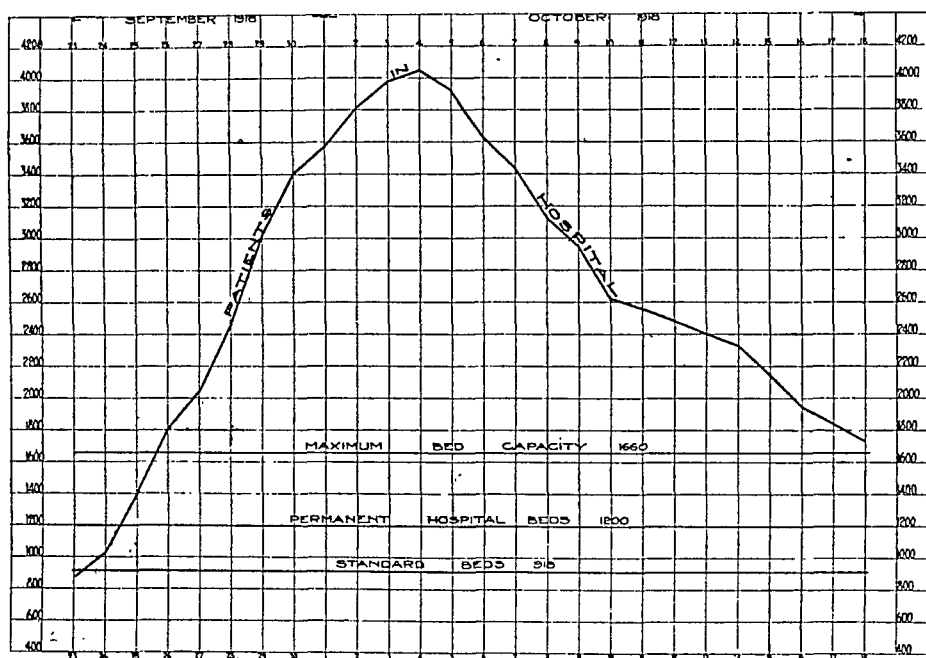


CHART I.—Patients in hospital day by day.

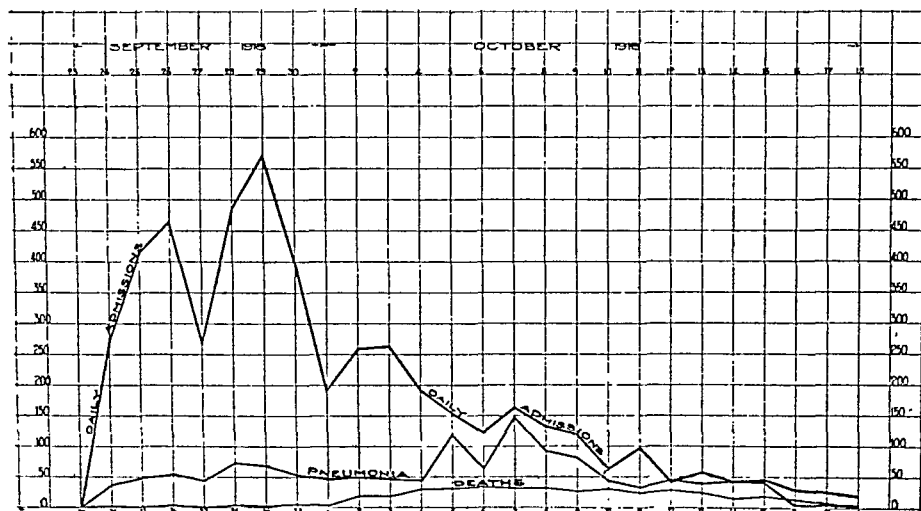


CHART II.—Daily admission, showing pneumonias in hospital as reported and deaths day by day.

patients then began to get up and sit on the edge of the beds. They were all weak and some fainted in trying to get out of bed. The more severe cases had fever for three or four days. Practically all cases that had fever longer than this proved to have broncho-pneumonia. Many had vomiting; some became tender over the

abdomen, imitating an intra-abdominal condition. (See Appendix I for a typical case, Chart 3.)

There was a leukopenia in practically all cases and no rise of leukocytes with the advent of pneumonia.

Besides the ordinary symptoms, a striking feature in the early stages of these cases was the bleeding from some portion of the body. Our statistics show that 15 per cent. suffered from epistaxis. Everywhere one went he saw men with bleeding or packed noses. Fifty cases of subconjunctival hemorrhage were counted. Twelve had a true hemoptysis, bright red blood with no admixture of mucus. Six cases vomited blood. One case died from loss of blood from this cause. Among the nurses, menstruation began in about 80 per cent. two or three days after going to bed. Three cases had intestinal hemorrhage. Most of the bleeding came early, with the exception of three cases of hemoptysis, which came after bronchopneumonia had begun.

Twelve to fifteen per cent. of all cases had herpes either of the lips, tongue, nose or mouth, the eruption being exceedingly extensive in some cases.

Pneumonia developed secondarily to the influenza in 1342 cases, and the complications given below must be regarded as complications of this disease, in most cases, rather than influenza.

Jaundice of a mild or severe degree developed in 112 cases of bronchopneumonia. In those recovering the jaundice disappeared very rapidly, in some cases clearing up entirely in seven or eight days. The liver in all cases seen was enlarged, so we believe it was a true cholangitis.

Otitis media has been reported in 41 cases. Fortunately the otologists were on duty day and night and did immediate paracentesis on all bulging drums. No mastoid operations so far have been necessary.

Infectious psychoses were seen in 18 cases, the patients exhibiting all grades of aberration from simple transient hallucinations to maniacal frenzy which needed mechanical restraint for twelve to twenty-four hours. Two of these cases have not cleared up at this date, one being free of all other signs and symptoms for four days; the other still having signs of his bronchopneumonia.

Two cases developed an hysterical aphonia (which cleared up in three and eight days respectively).

Five cases of pneumococcus meningitis were diagnosed clinically and proved positive by lumbar puncture; 6 to 8 cases were punctured that had some signs of meningitis; these all showed a clear fluid under pressure, no increase in cells and no bacteria.

Eleven cases of epidemic cerebrospinal meningitis were diagnosed and isolated during the epidemic; 3 cases developed after the patients were convalescing from pneumonia and had been in the hospital from three to four weeks. Report of this will be made later.

Cases with a friction rub were of such common occurrence that

we have not been able to give any reliable statistics as to numbers on them.

Emphysema cases have appeared at the end of the epidemic. Twenty-nine have been reported so far, 3 cases showed hemolytic streptococcus, 20 cases pneumococci, 7 cases no organism found.

The most interesting complication on account of its usual rarity has been interstitial emphysema, of which we have had 10 cases. Histories of the first case, with picture by Capt. A. L. Levin, and one of the two cases that have lived are hereby appended. (See Appendix I.) Also an autopsy report by Capt. Schultz on one of the cases. (See Appendix II.) The only reason that can be given for the great number of these cases is the violence of the cough and the degenerative changes brought about in the disease. All of these cases had influenza, followed by bronchopneumonia, the subcutaneous emphysema coming from six to ten days after the beginning of the disease. The air was first felt in all cases in a collar about the neck and then gradually spread over the back, chest and arms to the hands as far as the knuckles and down the thighs to the middle. A rupture of the bronchus at the root of the lung seems to us the only explanation.

Two cases after violent coughing developed a pneumothorax, the heart being pushed to the right as far as the midline on that side. (For autopsy on one case see Appendix II.) One case has proved to be a pyopneumothorax.

Capt. Levin presents a brief history and autopsy findings in one of the most remarkable cases of the epidemic, gangrene of the colon with rupture. (Appendix I.)

Briefly, in this paper, we have given the unusual complications in this epidemic. Unfortunately, we did not have the time or the facilities for doing some of the work that should have been done.

We can give no reason for the frequency of hemorrhages, but cannot help feeling that there must have been some definite change in the constituents of the blood, although we made no estimation of the coagulation and bleeding time nor counted platelets.

The effect of the influenza bacillus must be to prepare a fertile field for the pneumococcus, as we have never seen such virulent pneumonias either primary or secondary to measles. Death came rapidly and could be prognosticated practically from the moment the man entered the hospital. The object of this paper and appendices is to put on record for further use the disease as we have seen it. This should be worth while.

APPENDIX I.

CASE I.—Case of influenza; no complications.

Reg. No. 23,718. M. J., Pvt., Co. C, Dev. Bn. Admitted October 23, 1918. *Family History* and *past history* not important. *Present Illness*. Onset sudden, with aching over the whole body and pains in the head and cough.

Examination. Signs of a bronchitis. Sputum shows *Bacillus influenza* and Type IV pneumococcus.

Blood Count. Whites, 5000; polymorphonuclears, 48 per cent.

Urine. Negative. (Chart III.)

CASE II.—Case of interstitial emphysema bilateral (died).

Reg. No. 19343. C. J. R., white, aged twenty-three years. Native of Louisiana, carpenter, robust physique. Four months in service. Onset of influenza September 23, 1918. Admitted September 24, 1918. Symptoms of influenza. Diagnosed: Bronchopneumonia at base of right lung on September 30, 1918. Coughed



FIG. 1 (Case II).—Showing bilateral interstitial emphysema.

violently when temperature lowered; cautioned about it. Began to improve when subcutaneous emphysema developed at 3 P.M. on October 6, 1918. Died at 10 A.M., October 8, 1918.

Past History. Malaria, treated at Base Hospital.

Diagnosis. Interstitial emphysema bilateral.

Result. Death. (Fig. 1, Chart IV.)

CASE III.—Case of interstitial emphysema (with recovery).

Reg. No. 22920. H. N., Pvt., Co. K, 5th Infantry. Admitted to hospital October 5, 1918. Diagnosed: Bronchopneumonia October 8, 1918.

October 12. Became delirious and unmanageable.

October 13. Subcutaneous emphysema developed over the left

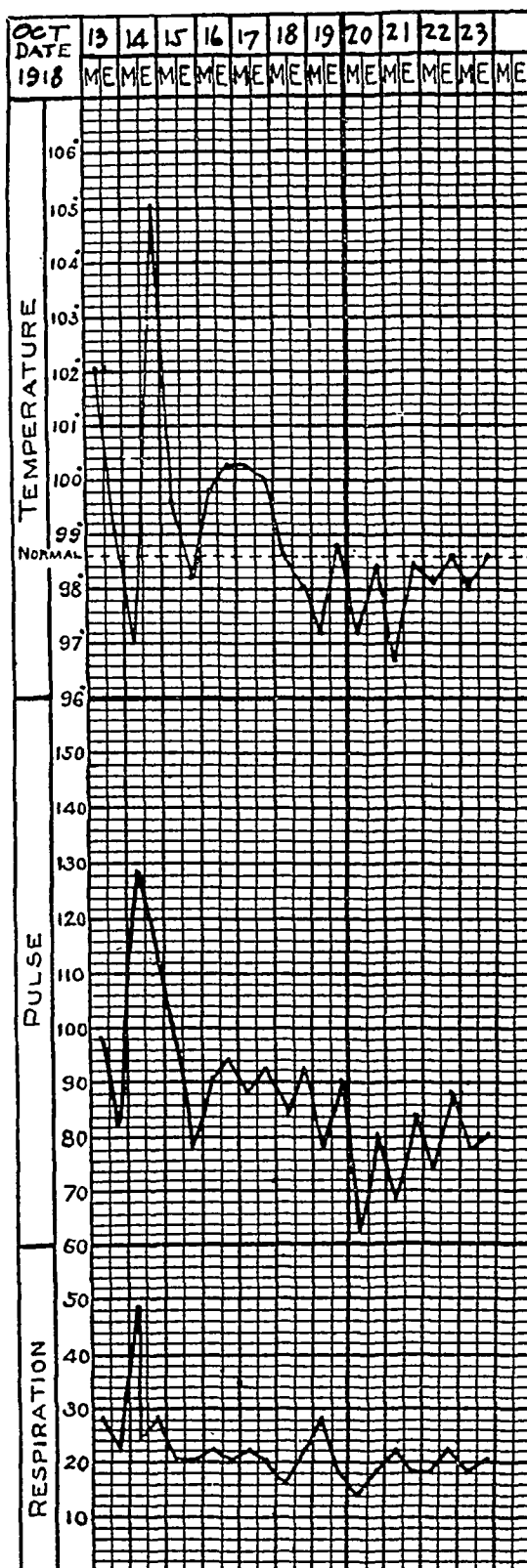


CHART III.—Clinical chart of Case I, uncomplicated case of influenza.

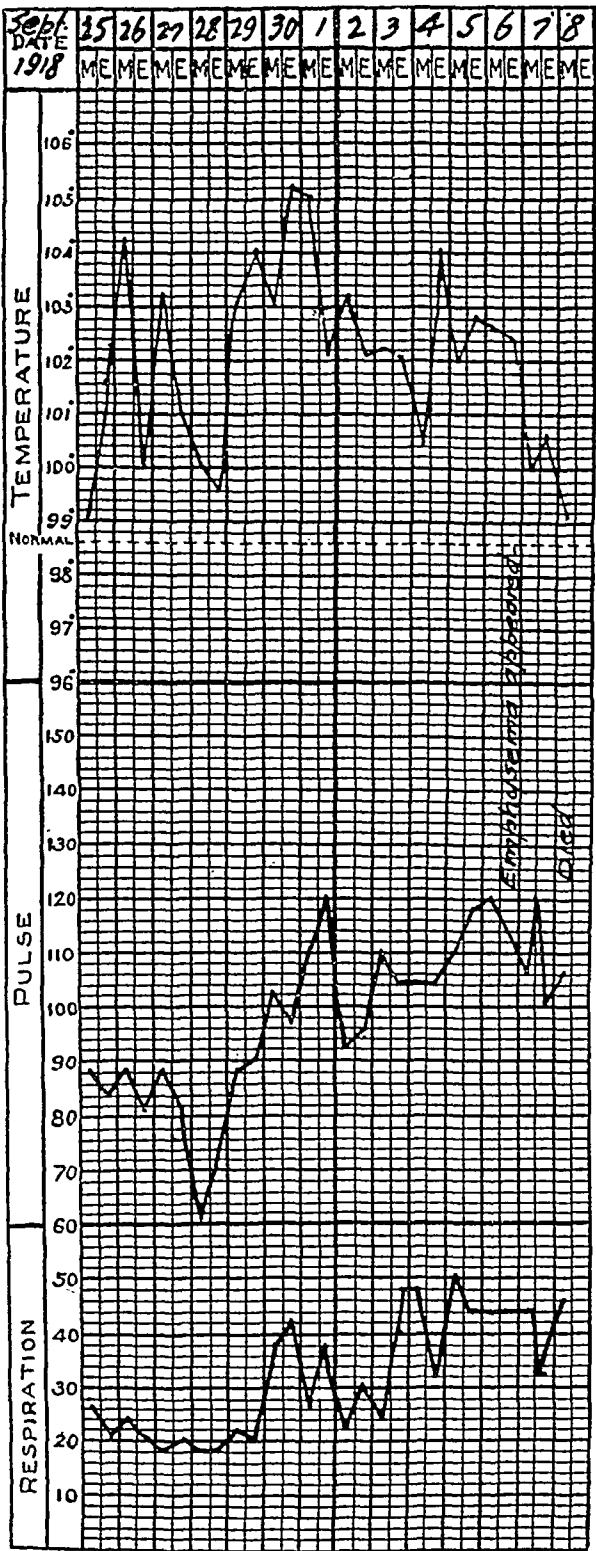


CHART IV.—Clinical chart of Case II. Fatal bilateral interstitial emphysema.

chest, left arm and hand. Same day developed a tremor over the whole body; eyes wild and staring; talks incessantly.

October 16. Patient wants food; lungs better.

October 20. Emphysema practically disappeared except under left clavicle.

October 28. Practically well; chest clear; emphysema gone. (Chart V.)

CASE IV.—An unusual complication of bronchopneumonia, Type III.

Reg. No. 23476. C. C., Pvt., Co. G, 29th Infantry. Miner by occupation. Three and a half years in service. Admitted October 9, 1918, with influenza. Bronchopneumonia detected on October 11, 1918, left lung, Type III sputum and blood culture.

October 18. Marked abdominal distention noticed (upper abdomen).

October 10. Purulent pleural fluid obtained; culture: pneumococcus, Type III. Plastic pneumococcus peritonitis suspected on October 20.

October 23. Distention relieved.

October 25. Pus obtained from left chest. Operated on the same evening, 9.30 P.M. Dyspnea, cyanosis, collapse. Died 11.50 P.M.

October 26. Autopsy: Plastic pneumococcus peritonitis, rupture of transverse colon the entire length; gangrenous, fecal matter freely in pocket. Transverse colon eight inches in diameter; small and large intestines agglutinated.

APPENDIX II.

Autopsy Protocol, No. 1.

Name: E. V.

Autopsy No. 6.

Rank: Sergeant, Co. E, 5th Infantry.

Time of death: 2 A.M., September 28, 1918.

Time of autopsy: 9 A.M., September 28, 1918.

Admitted: September 26, 1918.

Clinical Diagnosis. Lobar pneumonia, right lower.

Anatomical Diagnosis. (1) Acute catarrhal bronchitis; (2) diffuse bronchopneumonia of both lower lobes; (3) acute hemorrhagic pleuritis of right lung; (4) acute splenic tumor; (5) cloudy swelling of liver, kidneys and myocardium.

External Examination. The body is that of a well-developed, white male, about seventy-one inches long, weighing about 185 pounds. Strong rigor is present, and there is marked lividity of the posterior surface of the body and of the left side of the face. There are no external marks of injury or of identification.

Internal Examination. A thin layer of subcutaneous fat is present. The peritoneal cavity is free of adhesions and of fluid. The pericardial cavity contains a slight excess of fluid which is partly clotted. The left pleural cavity is normal. The right contains a slight excess of fluid, which is faintly clouded and slightly blood-tinged.

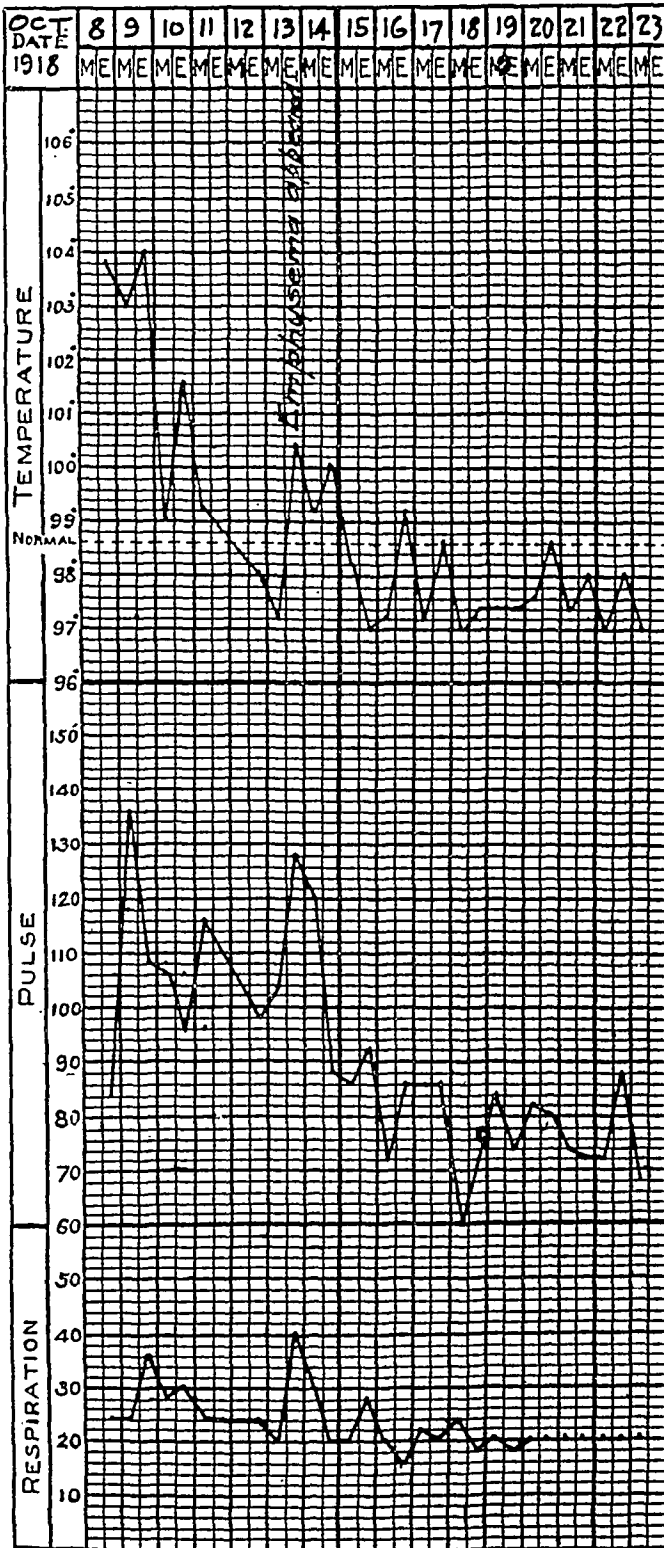


CHART V.—Clinical chart of Case III. Interstitial emphysema, with recovery.

Lungs. The pleural surface of the left is smooth and glistening. The lower lobe, although it contains air, feels heavier and less crepitant than normal. On section the lower lobe is congested, and the cut surface, from which frothy fluid escapes, is very finely granular, the appearance suggesting the consolidation of innumerable groups of small numbers of alveoli, these being separated by small groups of air-containing alveoli. The upper left lobe is crepitant and pale pink in color. The pleura of the lateral surface of the right lung is finely granular and hemorrhagic, but its surface contains the fibrin. The lower lobe is congested, and like the lower left lobe is heavier and less crepitant than normal. On section it is somewhat more deeply congested than the lower left lobe, but has the same very finely granular appearance. The upper and middle left lobes appear normal. The bronchi of both lungs are deeply congested, but contain no exudate.

Heart. The right side is distended with blood. All the valves and the root of the aorta are normal. The heart muscle is pale and cloudy.

Spleen. The spleen is enlarged to about three times the normal and feels rather soft. The outer surface is smooth and is dark bluish red in color. On section the tissue is dark red and much blood escapes from the surface.

Liver. Normal externally. On section the tissue is cloudy. Gallbladder and ducts are normal.

Kidneys. Each is slightly increased in size. On section the cortex is swollen and cloudy and the glomeruli stand out as minute, slightly congested points.

Adrenals, pancreas, gastro-intestinal tract, bladder and prostate. Negative.

Bacteriology. Cultures from the heart's blood and from the fluid of the right pleura show no growth. Smears from the lower lobes of the lungs show Gram-negative small bacilli and Gram-positive diplococci. Cultures from the lung yield *B. influenzae* and a Gram-positive, bile insoluble, non-hemolytic streptococcus.

Autopsy Protocol, No. 2.

Name: F. W. T.

Rank: Pvt., Co. E, Dev. Bn.

Admitted: September 29, 1918.

Died: 9 A.M., October 4, 1918.

Autopsy: 10 A.M., October 4, 1918.

Clinical Diagnosis. Lobar pneumonia.

Anatomical Diagnosis. (1) Lobar pneumonia of the right lower lobe (red hepatization); (2) pseudolobar pneumonia of the left lower lobe; (3) bronchopneumonia of both upper lobes and of the right middle lobe; (4) acute catarrhal bronchitis of both lungs; (5) acute fibriopurulent pleuritis of right lung; (6) acute splenic tumor; (7) cloudy swelling of liver, myocardium and kidneys.

External Examination. The body is that of a slenderly built

white male, about seventy inches tall, weighing about 146 pounds. The body is still warm and rigor is absent. The neck and face are cyanotic. On the inner surface of the left knee is a large old scar of a burn.

Internal Examination. Peritoneal, pericardial and left pleural cavity are normal. A thin layer of yellow exudate is present over the lower outer half of the right upper lobe and between the lobes.

Lungs. The lower lobe of the left lung is occupied by irregularly shaped confluent patches of dark red, airless tissue, which is congested and granular on section. A smaller wedge-shaped area is present at the lower border of the right upper lobe. The right lower lobe is completely consolidated and on section the tissue is dark red and granular and contains much blood. A few small patches of consolidation are present in the right upper and middle lobes. The bronchi of both lungs are congested and contain no exudate.

Heart. Negative except for cloudy swelling of the muscles.

Spleen. The spleen is increased to twice the normal size. On section the tissue is dark red and soft.

Liver. Cloudy.

Kidneys. The cortex is swollen and cloudy.

Adrenals, pancreas, gastro-intestinal tract, bladder and prostate. Negative..

Bacteriology. Smears from the right upper and lower lobes and from the pleural exudate contain many Gram-positive diplococci. Cultures from these situations contain pneumococci. Culture from the spleen is negative. The heart's blood culture is contaminated by a large Gram-negative bacillus, but contains Gram-positive diplococci, which prove to be Type IV pneumococci in the peritoneal exudate of a mouse injected with the culture.

Autopsy Protocol, No. 3.

Name: R. F.

Rank: Pvt., Co. H., 5th Infantry.

Admitted: September 26, 1918.

Died: 12.50 P.M., October 10, 1918.

Autopsy: 3.30 P.M., October 10, 1918.

Clinical Diagnosis. Influenza. Bronchopneumonia of the left lower lobe. Interstitial emphysema bilateral.

Anatomical Diagnosis. Interstitial emphysema bilateral. (1) Pseudolobar pneumonia of both lower lobes; (2) bronchopneumonia of both upper lobes and of the right middle lobe; (3) interstitial emphysema of the mediastinum and of the subcutaneous tissue of the face, neck, thorax and arms.

External Examination. The body is that of a sparely built white male about sixty-six inches tall, weighing about 130 pounds. Rigor and lividity are not present. The skin of the right side of the face and of the entire neck appears swollen, and on pressure it has a crepitant crackling feel. The same crepitant sensation is elicited upon pres-

sure of the skin of the chest anteriorly as far down as the nipple line, laterally on both sides of the chest to a slightly lower level and about half-way down on both arms. The skin of the crepitant regions is not discolored.

Internal Examination. The peritoneal cavity is normal. When the sternum is removed the tissues of the mediastinum are found filled with air, which occurs in the form of bubbles of varying size held in the loose tissues. The loose tissues of the root of the neck show a similar condition. The pericardial cavity is normal. Both pleural cavities are free of fluid and of adhesions. The lungs are not collapsed and no air is present in the pleural cavities.

Lungs. The two lungs are removed *in toto*, together with the trachea. Bubbles of air are present beneath the pleura of the left lung; these bubbles follow the lines of the interlobular septa. The pleura of each lower lobe posteriorly and laterally is granular and cloudy, but no macroscopic fibrin is present. All the loose tissue about the roots of the lungs contain bubbles of air. The lungs feel heavy, the lower lobes being enlarged and dark red in color. Areas of consolidation are present in both upper lobes, and about half of the right middle lobe is solid. Although the lower lobes are almost completely consolidated, small areas of air-containing tissues are present at the margins and in several places beneath the pleura. When the lungs are immersed in water and inflated by a tube placed in the trachea a steady stream of air bubbles escape from the tissue at the bifurcation of the trachea, the air apparently coming from the left bronchus anteriorly at the level of the bifurcation. On opening the trachea a small tear is found in the mucosa of the anterior wall of the left bronchus in the region from which the air was seen to escape. On section of the lungs both lower lobes are dark red and granular. Scattered about in the dark red tissue are numerous more opaque gray areas two or three lobules in size; these areas appear to have a peribronchial distribution. The right middle and both upper lobes contain areas of consolidation, of varying size, which are grayish red in color and rather soft and friable. The bronchi contain no exudate and their mucosa is not reddened.

Spleen. The spleen is moderately enlarged, firm and dark red. The remaining organs were not examined further.

Bacteriology. Smears and cultures from the right lower lobe show nothing. Cultures from the spleen and heart's blood remain sterile. Smears from the left lower lobe show a few Gram-positive diplococci; the cultures show numerous Gram-negative small bacilli and Gram-positive cocci in pairs and chains. The latter type are Type III pneumococcus.

Autopsy Protocol No. 4.

Name: W. McC.

Rank: Pvt., Co. A, M. P.

Died: 5.15 A.M., October 20, 1918.

Autopsy. 11.00 A.M., October 20, 1918.

Clinical Diagnosis. Pneumothorax.

Anatomical Diagnosis. Pneumothorax (left); suppurative pneumonia of the left lung; bronchopneumonia in the right.

Histological section of the tissue of the right lung, left lung and spleen.

External Examination. The body is that of a well-developed male, weight about 165 pounds, six feet in height. Rigor mortis is present. The skin is clear and there are no deformities or marks; the appearance of his face indicates some emaciation.

Internal Examination. An incision is made from the suprasternal notch to the pubes. The subcutaneous tissue is in good shape.

Lungs. The left lung has completely collapsed. It is nodular, grayish in color which is due to a fibrinous exudate, but there are no adhesions and a little fluid containing pus in the pleural cavity. On section pus flows freely from every nodule. The lung is full of abscesses ranging from the size of a hen's egg to minute abscesses. The bronchi are filled with pus. The right lung has a consolidation in the lower posterior portion of the upper lobe involving the upper posterior third of the lower lobe. The rest of the lung feels as though it is in fairly good shape with plenty of air in it. On section there is pus in the consolidated portions and also, some little pus in the bronchi. The air cells in the seemingly good portions of the lung contain in various areas a little frothy fluid but there are no evidences of inflammation. There are no adhesions except the adjacent consolidated portion. There is little fluid in the right pleural cavity.

Heart. The heart is negative.

The *liver, pancreas, intestines* and *peritoneum* are all negative.

Spleen. The spleen has an infarct about the size of a fifty-cent piece on the upper anterior third. On section it seems inflamed and is somewhat enlarged.

Kidney. The right kidney is large, red and seems swollen, and the capsule peels off easily, but on section it is negative. The left kidney seems identical with the right. The appendix is negative.

BACTERIOLOGICAL OBSERVATIONS ON THE EPIDEMIC OF INFLUENZA AT CAMP BEAUREGARD, LA.

By J. E. McCLELLAND, M.D., CAPTAIN, M.C., U.S.A.,

CLEVELAND, OHIO.

THERE has been so much discussion and uncertainty, so much curiosity and inquiry regarding the etiological factors in the prevailing epidemic of so-called Spanish influenza, that it is deemed appropriate to report the results of our work at this Base Hospital.

The epidemic began here on or about September 24, 1918, and lasted approximately three weeks, the apex of the epidemic being reached about the end of the first week. This report is based on the observations made between September 24 and October 20. During this period there were admitted to the Base Hospital 4980 cases diagnosed clinically as influenza, and of these 1322 developed pneumonia. There were 416 deaths. The entire number of the troops in the division here is approximately 13,000. In addition to the cases admitted to the Base Hospital there were many of those less severely sick who were treated in the regimental infirmaries and quite a considerable number who never went on sick report at all. Several of the enlisted men in the laboratory belong in this last category. It would seem a conservative estimate to say that at least 50 per cent. of the command acquired the infection. Of 300 nurses, 149 were taken sick, and of 610 men in the Base Hospital Detachment 327 went on sick report. These figures are enumerated merely to convey some idea of the magnitude of the epidemic.

On the first day of the epidemic it was decided to select two widely separated wards and make nose and throat cultures on every patient. Half of the cultures were taken on whole blood-agar plates and half on laked blood-agar plates. One plate was used to a patient, the nasal swab being smeared over one-half and the throat swab over the other half. On the same day specimens of sputum from patients with productive coughs were examined microscopically and washed portions injected intraperitoneally into mice. Next, six of those patients that had the highest temperatures were selected as subjects for blood cultures, 10 c.c. of blood being inoculated into 150 c.c. of plain meat-infusion broth.

The examination of the nose and throat cultures the following day showed that the vast majority of the plates contained countless numbers of small colonies transparent to transmitted light, and of such minute size that often the aid of a hand lens was required for identification. Smears from these colonies showed large numbers of small Gram-negative bacilli having in general the morphology and staining characteristics of the *B. influenzae*, but showing considerable pleomorphism. Colonies were fished and subcultures made and the same organism obtained in pure culture. The organism proved to be a very delicate one, and even when subcultured daily on blood medium soon died out. It was observed that while large numbers of colonies were obtained from both nose and throat the greater numbers were found in the throat cultures. In one ward 35 patients were cultured and everyone showed positive cultures as described above. Three of the plates also showed hemolytic streptococcus colonies. Unfortunately we cannot report exactly on the cultures from the other ward, as part of this record was lost. However the findings were practically identical. As described by others it was our experience that the influenza colonies

grew to much larger size when in the vicinity of staphylococcus colonies. In the second ward there were found five hemolytic streptococcus carriers.

The direct microscopic examination of the specimens of sputum showed both small Gram-negative bacilli and Gram-positive diplococci, the latter predominating. From the peritoneal exudate and the heart's blood of the inoculated mice both *B. influenzae* and Type IV pneumococci were obtained.

All the six blood cultures taken on the first day of the epidemic remained sterile, nor were we able subsequently to identify *B. influenzae* in any of our blood cultures.

It was then decided to make throat cultures of the entire hospital, as far as practicable, with the idea of determining how many patients would show typical influenza colonies, and also in order to locate the hemolytic streptococcus carriers, that they might be isolated from the other patients. From September 25 to October 3, throat cultures were made on 1919 patients. Of these 1749, or 91.1 per cent., were positive for influenza, 80 were positive for hemolytic streptococcus, 39 showed both influenza and hemolytic streptococcus and 90 were negative. The total number of hemolytic streptococcus carriers then was 109, or 5.7 per cent. of the entire number cultured.

Lieut. Fitchet performed an interesting experiment. Holding open plates two or three feet in front of patients, he had them cough in the direction of the plates. After incubation all these plates showed many influenza colonies, thus demonstrating the ease of the transmissibility of the infection through unguarded coughing.

As soon as the cases of pneumonia developed the attempt was made to make microscopic and bacteriological examinations on as many of the sputa as possible. While many of the direct smears showed numerous Gram-negative bacilli, the predominating organisms were Gram-positive diplococci having the morphology of pneumococci. Type determinations for pneumococci were made on 723 cases, using the Avery method. The results of this investigation are shown in Table I. The outstanding features of this table are

TABLE I.—TYPE DETERMINATIONS FOR PNEUMOCOCCUS ON THE SPUTUMS OF 723 CASES OF POST-INFLUENZA PNEUMONIA. (AVERY METHOD).

	Cases.	Per cent.
Type I	8	1.1
Type II	61	8.4
Type III	84	11.6
Type IV	570	78.9
	<hr/> 723	<hr/> 100.0

the high percentage of Type IV pneumococcus and the relatively large number of Type III and the small number of Type I. However, from a consideration of the relative incidence of the various types

in normal carriers it would seem reasonable to suppose that many of the patients developed a pneumonia that was really an auto-infection from the organisms already present in their own upper air passages. Undoubtedly the added influenza infection played a very important role either in reducing the patients' general or local resistance to secondary infection, or in some way enhancing the invasiveness of those organisms which were shown to be the most important etiological factors in the complicating pneumonias. At any rate the combined infection was much more virulent and fatal than a pure infection would have been. Moreover, the character of the pneumonia, as given below in the summary of the autopsies, was quite different anatomically, and much more extensive in its distribution than the typical lobar type we are accustomed to associate with pneumococcus pneumonitis.

BLOOD CULTURES. It was thought important to make blood cultures on as many of the sick pneumonias as time and equipment would permit, in order to check up on the sputum examinations and to determine accurately the true etiology of the pneumonias. The technic was simply to inoculate 10 to 15 c.c. of blood into 100 to 150 c.c. of plain meat infusion broth. Plates were not made routinely but only in specially selected cases. In all 129 blood cultures were made on 111 different patients, 54 of these patients, or 48.7 per cent., had one or more positive cultures, while 57, or 51.3 per cent., had negative cultures. In other words, practically one-half of the patients had a septicemia associated with their pneumonia. The bacteriology of the blood cultures is given in Table II. The high

TABLE II.—TYPE OF ORGANISM FOUND IN THE POSITIVE BLOOD CULTURES SHOWING THE HIGH MORTALITY.

	No. of cases.	Per cent.	Mortality.	Per cent.
Type I	5 ¹	9.3	2	40.0
Type II	7	13.0	7	100.0
Type IIA	7	13.0	6	85.7
Type III	12	22.2	12	100.0
Type IV	19	35.2	17	89.5
Hemolytic streptococcus . . .	3	5.5	3	100.0
Non-hemolytic streptococcus .	1	1.8	1	100.0
Total	54	100.0	48	88.8

percentage of positives obtained contrasts very strikingly with my former experiences in ordinary lobar pneumonia in soldiers as recently reported.² Here, again, the high percentage of Type III infections stands out conspicuously. All of the pneumonias accompanied with a Type III septicemia died. The very high mortality in all those cases with a septicemia shows the important part that invasion of the blood stream plays in bringing about a fatal termina-

¹ Two of Type I cases with septicemia received Type I serum and recovered.

² Jour. Am. Med. Assn., 1918, lxxi, 1299.

tion. Two of the Type I cases with septicemia received large doses of specific serum, and both recovered.

Serum Treatment in Type I Cases. Four of the Type I cases were treated with serum and all recovered. Two of these cases were extremely sick when the administration of the serum was started. One (E. L.) had a very extensive process involving the entire left lung and the lower lobe of the right lung, a positive blood culture showing three colonies per cubic centimeter; he developed a double otitis media requiring paracentesis, and an empyema appeared on the left side while the pneumonia was still active. He received 1200 c.c. of Type I serum. The empyema was drained and now the patient is convalescing satisfactorily. The other very sick Type I case had a severe septicemia, the blood cultures showing 41 colonies per cubic centimeter. The serum treatment was given intensively every eight hours for ten doses, the patient receiving 1000 c.c. A second blood culture taken two days after the first was negative. The other two cases were moderately sick and both recovered promptly. In this small series of Type I cases the serum treatment was satisfactory.

Hemolytic Streptococcus Cases. Three patients showed hemolytic streptococci in the blood cultures and all died, which coincides with my former experience that practically all cases of hemolytic streptococcus septicemia terminate fatally. In three other cases hemolytic streptococci have been recovered from the empyema fluids. Two of these cases have been operated on and the third has been treated by simple aspiration. All are still in the hospital, and it is still too early to predict the ultimate outcome.

Pneumococcus Meningitis. Only two of the pneumonias developed meningitis as a complication. Both cases showed a Type IV pneumococcus in the spinal fluids and in the blood cultures. One of these patients had such a severe septicemia that it was impossible even to approximate the number of colonies in the plates. Probably in both cases the meningitis was of hematogenous origin. Both patients died soon after the appearance of the meningitis. We have not encountered any cases of influenzal meningitis.

Empyema. To date (October 27) there have been 29 cases in which thoracenteses have revealed the presence of fluid in the pleural cavity. The bacteriology of these fluids is given in Table III. Again, the high percentage of Type III pneumococcus infections is remarkable. The number of sterile effusions (seven) seems rather large, but corresponds with my previous experience that the elaboration of a sterile pleural effusion is not uncommon following pneumonia. This type of cases gets along very well with simple aspiration and practically never require more radical surgical interference. The large number of empyema cases that showed pneumococci in the smears and cultures again indicates that organism as the true etiological factor in the majority of the post-influenzal pneumonias.

The influenza bacillus was not found in any of the cultures made from the pleural fluids.

TABLE III.—TYPE OF ORGANISM FOUND IN 29 CASES OF EMPYEMA FOLLOWING INFLUENZA AND PNEUMONIA.

	No. of cases.	Per cent.
Type I	4	13.8
Type II	0	0.0
Type III	6	20.8
Type IV	7	24.1
Undetermined	2	6.9
Hemolytic streptococcus	3	10.3
Non-hemolytic streptococcus	0	0.0
Sterile effusions	7	24.1
	<hr/> 29	<hr/> 100.0

Autopsies. During the early part of the epidemic twelve autopsies were performed. These were all done by Captain O. T. Schultz, and it is from his reports that the following notes are made.

In eight of the cases (protocols 8, 9, 10, 11, 12, 13, 14, 17) there was found a very extensive bronchopneumonia, most marked in the lower lobes, but, as a rule, involving portions of all five lobes. The process was usually so extensive in the lower lobes that Captain Schultz describes the pathology as pseudolobar pneumonia. In seven of these eight cases both *B. influenzae* and pneumococci were demonstrated in smears or cultures from the lung tissue, showing that these patients were suffering from a double infection. Seven of the eight cultures from the heart's blood were positive. Two yielded a Type II pneumococcus, two a Type III pneumococcus, and three a Type IV pneumococcus, and in one of the Type IV cases a pure culture of pneumococcus was also obtained from the spleen. Once more we call attention to the important role of the pneumococcus in bringing about the fatal termination. In none of these eight cases was there any pericarditis, endocarditis or peritonitis. The amount of pleuritis was small considering the extensiveness of the pneumonias, and none had any collection of fluid in either pleural cavity.

The remaining four autopsies (protocols 6, 7, 15, 16) differed essentially from the foregoing and merit separate descriptions. One case (protocol 15) showed bronchopneumonia of the left upper lobe, atelectasis of the right lung with a fibrinopurulent pleuritis with effusion (1000 c.c.) and fibrinopurulent pericarditis with effusion (250 c.c.). Cultures from the affected portions of lung, from the empyema fluid, from the pericardial fluid and from the heart's blood all yielded pure cultures of hemolytic streptococcus. This was evidently identical with the hemolytic streptococcus pneumonias which were so prevalent in some of the camps last winter, especially following measles.

Another case (protocol 16) proved to be a typical lobar pneumonia involving the right upper and lower lobes with a marked fibrinopurulent pleuritis. Smears and cultures from the affected lung showed many pneumococci but no *B. influenzae*. The spleen culture yielded pneumococci in pure culture and a Type IIA pneumococcus was obtained from the heart's blood. This case was evidently a straight uncomplicated lobar pneumonia.

The third case (protocol 7) was also a typical lobar pneumonia involving the right upper and middle lobes, with a marked fibrinopurulent pleuritis. In addition, however, there was an acute purulent bronchitis of both lungs. Smears from the right lung showed many Gram-positive diplococci, but the smears from the bronchial exudate of the left lung showed also many Gram-negative bacilli. Cultures from the heart's blood gave a pure culture of Type I pneumococcus. This patient had then both a pneumococcus pneumonia and an influenzal bronchitis.

The fourth case (protocol 6) showed a diffuse bronchopneumonia of both lower lobes, an acute hemorrhagic pleuritis of the right lung, with a slight amount of cloudy, blood-tinged fluid in the right pleural cavity. Cultures from the heart's blood and from the pleural fluid remained sterile. Smears from both lower lobes showed many Gram-negative bacilli and many Gram-positive diplococci. The lung cultures yielded a Gram-positive, bile insoluble, non-hemolytic streptococcus. This patient evidently had a combined influenza and streptococcus infection.

DISCUSSION. The post-influenzal pneumonias may be due to a secondary invasion by any of the ordinary organisms producing pneumonia, but they are apparently more severe, more extensive and often rapidly fatal. The severity of the secondary infection seems to be augmented by the coexistent influenzal infection. The majority of the pneumonias here were due to a secondary invasion by pneumococci, all types contributing, but Types III and IV standing out more conspicuously than Types I and II. The streptococcus, both hemolytic and non-hemolytic varieties, were responsible for a small percentage of the pneumonias. So far as we could determine none of the pneumonias were due to the *B. influenzae* alone, nor were we able to recover the *B. influenzae* from any of the blood cultures or pathological fluids or exudates.

SUMMARY. 1. The demonstration of *B. influenzae* was possible in a large percentage of the patients from whom nose and throat cultures were made.

2. About 5.7 per cent. of the patients were also found to be hemolytic streptococcus carriers.

3. The bacteriological examination of the sputa from patients with productive coughs showed both *B. influenzae* and pneumococci.

4. Examination of the sputum in the cases of post-influenzal pneumonia for type determination of pneumococcus (Avery method)

showed a preponderance of Type IV organisms with a relatively large number of Type III organisms.

5. Blood cultures were positive in about 50 per cent. of the pneumonia patients on whom cultures were made. Here again the high percentage of Type III and Type IV pneumococcus infection was in evidence. In no case was the *B. influenzae* recovered from the blood either antemortem or postmortem.

6. The mortality in the pneumonias with septicemia was very high (88.8 per cent.). All patients with a Type III septicemia died.

7. Although the number of Type I cases was small and only four received specific serum therapy all of these recovered, though two were desperately ill when the treatment was started.

8. The relative number of hemolytic streptococcus cases was small; all of those with a septicemia died.

9. There were only two cases of pneumococcus meningitis. Both of these patients had pneumococci in the blood stream.

10. The empyemas have not differed from those following the ordinary pneumonias. The *B. influenzae* has not been cultivated from any of the pleural effusions. Sterile pleural effusions have been of rather frequent occurrence.

11. The autopsies in the majority of cases showed a very extensive bronchopneumonia from which both *B. influenzae* and pneumococci were recovered in smears and cultures. The postmortem blood cultures usually showed some type of pneumococcus.

Capt. O. T. Schultz, Lieut. Fitchet, Lieut. C. C. Patton, Lieut. G. W. Debold and Lieut. S. C. Clark assisted in making and examining the nose and throat cultures. Contract Surgeon E. O. Trahan and his assistants made all the type determinations for pneumococcus on the sputa. Lieut. Fitchet assisted in making and examining the blood cultures. Capt. O. T. Schultz performed all the autopsies.

Our thanks are due to Lieut.-Col. J. T. Burrus, Commanding Officer, Major Donald J. Frick, Chief of the Medical Service, and Capt. R. C. Henderson, Chief of the Laboratory, for their hearty coöperation.

THE TREATMENT OF EPITHELIOMA BY RADIUM.¹

BY RUSSELL H. BOGGS, M.D.,

ROENTGENOLOGIST, ALLEGHENY GENERAL HOSPITAL; DERMATOLOGIST AND ROENTGENOLOGIST, COLUMBIA, PITTSBURGH AND ST. FRANCIS'S HOSPITALS,
PITTSBURGH, PA.

METHODS of treatment of epithelioma in the past have been as numerous and the end-results as variable as the types and degrees of malignancy. Epithelioma is cancer of the skin or mucous mem-

¹ Read before the Westmoreland County Medical Society, May 6, 1919.

brane requiring treatment as such, and the center should never be removed by caustics or plasters or even partially surgically. Primary epithelioma is not a surgical disease, because, in order to remove all the cancerous cells, it is nearly always necessary to remove too much healthy tissue. The permanency of the end-results in the past few years in many thousands of cases has shown that radiation far surpasses any other method.

Radium is the best form of radiation locally on the lesion and in regions where glandular metastases are likely to take place. Radium used over glandular centers or junctions, with complete roentgen treatment over the tributaries, is far superior to the most complete and often unnecessary dissection. The dissection of the glands in the neck is seldom indicated for epithelioma of the lip, or for epithelioma of the mouth or throat, if thorough radiation is given. The glands should be considered trenches and the lymphatic vessels avenues for passage of the enemy or cancer cells. Thorough radiation will sclerose the lymphatic system and lessen the danger of metastasis as well as destroy the epithelial or cancer cells which have already escaped unless the process is too far advanced. And even in the advanced cases, radiation always retards rather than hastens the malignant process as a complete dissection often does.

During the past eighteen to twenty years the writer has seen a large number of cases of epithelioma of almost every part of the body treated by almost every method, and it is surprising how many apparently innocent-looking lesions were rendered hopeless in a short time by incompetent treatment. No difference what method is used a certain number of early cases will be cured if the treatment is properly employed, but experience has proved that when radiation is given with judgment a larger percentage of cases can be cured. However, it must be remembered that radium and the roentgen rays will produce a mild reaction to a slough, that a knife will cut away any amount of tissue, that a slough of any size can be produced by cautery or chemical agents and so on with the different methods; but it is only by judgment and experience that the best results can be accomplished by any method and its limitations determined.

While radiation has been the most advanced step made in the treatment of malignancy during the past twenty-five years, it is not a specific like antitoxin for diphtheria or salvarsan for syphilis, and it is not the positive and certain cure for which we have been looking. Unfortunately, until the last two or three years, almost every surgeon operated upon every case of malignancy, regardless of the stage, without first considering any other method. Time has made a marked change, and each year there is a smaller percentage of surgeons removing epitheliomas. The great drawback in the past has been that many who have had a roentgen-ray machine or a few milligrams of radium, without having had experience, attempted to treat malignant growths. I do not mean to say that surgery is

never indicated, but I believe that it is seldom if ever indicated in primary cases.

It is a well-known fact that if a lesion is completely excised a permanent cure will result, such as those on the cheek with a small amount of scar, but in a series of cases the end-results are better by radium without leaving any scar. In some locations, as the nose, eyelids, etc., the surgical operation is more difficult and the deformity is objectionable. The large and deep-seated lesions are always difficult for the surgeon to excise with all the outlying cells and should always have at least a preliminary treatment. One of the weaknesses in surgery is that in attempting to have a good cosmetic result there is the great possibility of leaving malignant cells. Cutting out the center of a malignant process primarily and leaving outlying cancer cells to be followed by radiation will not give results equal to those obtained by at least treating the case primarily with radium or the roentgen ray.

Caustics may be divided into three classes, namely, chemical agents, actual cautery or electric coagulation. These have a place only as an adjunct to radiation. Their chief use is to remove broken-down necrotic tissue which has first been treated and sterilized by radium or the roentgen rays, and are only necessary in far-advanced cases. Before they are ever employed the lymphatics should be at least partially blocked by some form of active radiation.

The therapeutic action of radium on new growth is manifested primarily on the nuclei of the cells and inhibits the power of proliferation before the function of the cell is impaired. There is also a change produced in the small bloodvessels. The endothelial cells of the intima degenerate, the lumen of the vessels retract, finally becoming obliterated, and consequently the tumor cells cannot obtain the nourishment needed for their maintenance of life and for their proliferation.

Embryonic cells and those undergoing active proliferation are the most susceptible to radiation. It has been shown that malignant, growths are retarded by radiation and become less malignant, although they may not have diminished in size or disappeared. By further increasing the quantity of radiation the injury becomes more pronounced and the cells are completely destroyed, the rays acting differently on the various types of cells, destroying one kind of tissue and leaving the other adjacent tissue intact or so slightly injured that it will completely recover. Cancer cells are from three to seven times less resistant than normal tissue, depending upon the type of the lesion. Squamous-cell epithelioma requires from two to four times more radiation to eradicate the disease than the basal form. A few years ago this fact led many to believe that the squamous or the more malignant form could not be cured by radium. The reason for this was insufficient treatment.

The term epithelioma in the past has been unsatisfactory, having been applied to all epithelial growths, semimalignant or malignant, regardless of the degree or situation, which fact has accounted for such a diversified opinion in regard to many innocent-looking lesions, which in time show a malignant and destructive type. Epithelioma has certain pathological characteristics; it is a purposeless proliferation of cells extending beyond normal limits and invading adjacent tissues, especially the lymphatics, with slight inflammatory changes.

When the student leaves college he has been taught there are three varieties of epithelioma, namely, superficial, deep and papillary; but it means very little to him, and he has only a vague idea of epithelioma and its treatment. As a rule epithelioma, in the early stages, does not seem to cause much alarm among the inhabitants of a community, nor even among many physicians, and for this reason many patients with lesions of the innocent-looking type come late after they have been treated by superficial caustics, and are in a hopeless condition. The disease comes on slowly, so slowly that often no one takes notice of it until it is far advanced. After the age of forty all lesions which are constantly inflamed and scaly or show any degenerative changes should receive prompt attention. Prophylactic treatment of all excrescences, such as warts or degenerated moles, the removal or correction of any irritation of the skin or mucous membrane, the proper treatment of cracked lip, persistent spots of eczema or leukoplakia, would often save the patient a long and expensive treatment and oftentimes the life of the patient. Precancerous changes should always receive prompt attention by the physician. From the therapeutic standpoint we must determine whether we are treating basal-cell epithelioma or a squamous-cell type. Rodent ulcer or basal cell is characterized by its steady and progressive spread and is usually observed on the upper part of the face about the nose and eyes. It is extremely destructive, eating deeply into the tissue; in fact, destroying everything in its way without any tendency toward metastases or glandular involvement.

We have four classes of epithelioma in respect to method of treatment: (1) the lesion which can be cured by one application of radium with the proper dosage; (2) the lesion which is so situated that glandular involvement is likely to take place or has already occurred and in which the roentgen rays should be employed as an adjunct to treat the adjacent glands; (3) those cases in which the local application of radium supplemented by the roentgen rays will only act as a palliative measure; (4) those cases in which radiotherapy should be followed by excision or fulguration.

On account of the nature of the cases, as well as the lymphatic supply, epithelioma of different locations will be described separately. The virulence of an epithelioma, increases or decreases proportionately with the richness or poverty of lymphatic supply. Before

giving a prognosis of epithelioma, besides the location, several factors must be taken into consideration, namely, variety, extent, duration and rapidity of process. In many superficial forms the disease if neglected is slow in its progress, but eventually it will become dangerous to life if left untreated. In all instances the treatment should be given early, because it then requires less radiation and there is less chance of return. In the early stages, when the disease is limited to the face and of the superficial type, the treatment is almost invariably successful and permanently so. In this location, even when moderately advanced, the results are favorable in a large percentage of cases, but it requires so much more treatment. Good results are obtained in the deep-seated and papillomatous forms in the early stages, but in these cases glandular involvement occurs early.

The prognosis is not so favorable in epithelioma in which marked destruction has already taken place and in which there is considerable infiltration of the surrounding tissues, particularly so if the glands are invaded.

The basal form of rodent ulcer is amenable to treatment, but when left untreated or treated improperly is always of a serious nature, because this type of epithelioma seldom invades glands but destroys everything in its way.

Epithelioma of the upper part of the face, when the lesion is small, will usually respond to one application of radium. In epithelioma of the eyelids radium can be brought in contact with the lesion and there is little or no danger to the eye, and before the cartilage is invaded a small amount of radium will effect a cure. Recurrent lesions which have been treated by caustics are very resistant because the cartilage is usually involved and the infiltrated scar does not respond so promptly. The cosmetic results in the primary cases which have not been treated by caustics are frequently surprisingly good even when the lesion is rather extensive. The resultant scar is smooth, pliable and not thick and elevated like that following caustics or even a cutting operation.

Results in the treatment of epithelioma of the lower lip by radium, supplemented by the roentgen rays, are proved equal or superior to those obtained by surgery. This is a perfectly legitimate method of treatment, but must be carried out thoroughly. It is liable to abuse, however, the same as surgery has been in the past. Epithelioma of the lower lip is always a serious condition, and when radiation is given it must be employed in such a manner as to destroy all the cancer cells in the local lesions and in the adjacent lymphatic glands. With efficient treatment over 90 per cent. of the early cases are permanently cured without producing any deformity, more advanced cases are cured and hopeless cases receive retardation and palliation which cannot be accomplished by any other method.

In my opinion surgery, in most instances, should be reserved for

advanced cases and then only in cases after the cancer cells in the local lesion and glands draining the lip have either been entirely destroyed or in cases in which only a few cancer cells remain which are not very malignant in character. In advanced cases usually it is better not to push radiation up to a point where the superficial tissue will undergo a marked degeneration or a necrosis. It is much better to use a combination of methods and have the lesion removed surgically or by fulguration after it has been radiated and then follow up the treatment again. Radium has the advantage of not leaving a contracted scar which so frequently follows the removal of a V-shaped portion of the lip and in which a recurrence frequently takes place. Even with the best surgery a large amount of contraction takes place and later the movement of the mouth often irritates the scar and is undoubtedly the cause of the recurrence. We know that irritation is the cause of cancer in the healthy tissues, and once the lip has been invaded by cancer cells this is more likely to occur.

Before treating epithelioma of the lower lip a careful study should be made of the lymphatic glands and the manner in which they metastasize. The lymphatics draining the lower lip are the submental, which receive the lymphatic vessels from the chin and the central portion of the lower lip and the submaxillary which receive the lymphatics of the lateral portion. The submaxillary salivary gland is closely connected and often metastasizes. There is an anastomosis between the lymphatics which drain both sides of the lower lip as well as those draining the central portion. This must be remembered when radiating the lymphatics of the neck. The deep cervical chain extends from the mastoid process to the clavicle; some of the glands lie behind the internal jugular and subclavian veins and cannot be reached surgically without the removal of the jugular. The cervical glands metastasize from the submental and submaxillary. When the submental and submaxillary are palpable some cancer cells usually have reached the deep cervical chain. Early invasion of the lymphatic chains must be realized, and treatment by radiation must be given as carefully as a radical operation is performed. The writer has seen many cases of epithelioma of the lower lip in which only the lesion on the lip received treatment and in which at the same time the lymphatic glands were involved.

The objection to surgical removal is the frequent recurrence in the scar, because the operation on the glands cannot be sufficiently complete, no matter how thoroughly the dissection is carried out. The removal of the submental part of the parotid, submaxillary and all the glands which metastasize, together with the ligation and excision of the jugular is no easy task; besides, often leaving cancer cells in deeper glands which cannot be reached.

Today the radiotherapist has seen early cases in which a diagnosis is yet questionable; he has seen cases a trifle more advanced after radical operation in which he administered prophylactic

radiation as well as in many hopelessly inoperable cases. He not only sees more cases in a year than any individual surgeon of equal standing and reputation, but he works earnestly over many cases after they have been abandoned by the family physician, dermatologist and surgeon. He is in the best possible position to compare different methods of treatment from the standpoint of ultimate results. In short, he has a broader clinical knowledge of the subject than any other physician.

When ulceration has taken place, early surgical removal, wide and radical, is followed by recurrences in more than 50 per cent. of the cases in which there are no palpable glands at the time of operation and in more than 75 per cent. in which there is any glandular involvement. All precancerous lesions should be removed by some method without leaving any scar whatever.

Results in the treatment of malignant growths of the mouth and throat have not been successful by the older methods. When removed surgically even the smaller lesions are prone to recur; cautery in selected cases may give slightly better results and the end-results obtained by those using radium alone, such as the radium institutions, are not much better except in the early cases. The pessimistic tone of the reports from the London radium and other institutes must be discounted when it is recalled that most of these institutions treat only inoperable cases, and with radium alone. Radium, except in the early cases, should be combined, with other suitable measures, in order to obtain the best end-results.

In all examinations of the mouth and throat, precancerous lesions, such as leukoplakia, should always be looked for and treated promptly. Many of the earlier epitheliomas, before they have invaded the deeper tissues, will respond to one application of radium. It is to be remembered that the persistent lesions in the mouth and throat are nearly always malignant or luetic. Superficial cautery seldom removes a malignant lesion and nearly always hastens metastases.

I am sorry to say that so many cases are referred after superficial cautery has been employed in which the growth has not only been aggravated but deep metastases have taken place. Many physicians, not realizing the malignancy of these lesions, will often try cauterization or some inert mouth-wash, allowing the disease to become far advanced before they refer their patients to a laryngologist or for radium treatment. There is no place where it is more important to have early and proper treatment than in the mouth and throat. The selection of the method depends not only on the location and extent of the lesion but also on the experience of the operator or the radiotherapeutist. Roentgenization of the lymphatic glands should always supplement radium therapy as described for cancer of the lip.

No difference what method is employed a preliminary application

of radium in advanced cases is always of great service, as we have no other agent which destroys cancer cells to the same extent without injury to healthy tissue. Preradiation, in fact, makes cancer cells latent by stopping cell-proliferation early in the treatment and prevents spreading of the disease when other procedures are employed.

Electric coagulation or fulguration is a method which I have employed, after a preliminary treatment of radium to the growth in advanced cases and roentgenization of adjacent lymphatic glands, with some excellent end-results, even in advanced cases. The advantages of electric coagulation are the destruction of tissues without opening the blood- and lymph-vessels and the prevention of dissemination which might occur with a cutting operation. The large amount of carcinomatous tissue which can be destroyed by electric coagulation without hemorrhage is an item of great importance, which compels serious consideration by those who have treated many malignant cases. I have a few cases of advanced or inoperable carcinoma, including the floor of the mouth, buccal mucous membrane and tonsils, which were clinically cured by giving preliminary radiation followed by electric coagulation, and will be reported later.

Recurrences in the cicatrix and the glands frequently follow even when the tumor has been completely excised in its early stage. So frequently is this the case that we are bound to conclude that in many cases it is regional and not entirely local from the beginning, even before the neoplasm is scarcely recognizable by the naked eye, because the whole of the lymphatic circulation as well as the glands are already infected.

Delay in treatment of epithelioma of the mouth is not wholly responsible for the unsatisfactory results by surgery or even by any method in a certain percentage of cases. However, in these cases, in equal stages, the character of the end-results by radium surpasses the results by any other method. When patients have a very unhealthy mouth the gums are retracted from the teeth and there is more or less pyorrhea, the teeth are loose, and the whole mouth gives the appearance that the patient is suffering from lead-poisoning. The same results must not be expected as when the mucous membrane surrounding an epithelioma is healthy and the tissue has the usual normal resistance. Such cases often do badly by any method and the process is only retarded for a time by radiation. Also, as good results must not be expected in a luetic mouth as in a healthy patient.

Epithelioma of the back of the hand usually responds to treatment, but the prognosis is not so favorable as with the ordinary face cases, because the axillary glands are often early invaded. Therefore small lesions should have prompt and thorough treatment. No one realizes this better than the roentgenologists who have had keratosis on their hands. Some authorities state that progress in

epithelioma in this situation is slow and there is less liability of grave ulceration than epithelioma in other situations. This has not been my experience entirely. They have been usually slow in progress, but the lymphatic glands were invaded in many cases that I have seen at the time they were referred. Therefore, even the axillary glands should receive treatment.

Epithelioma of the genitals is always a serious matter, although with the proper treatment in the beginning the results are often successful. Left untreated until far advanced, palliation is all that can be expected from any form of treatment.

Paget's disease or eczematous epithelioma of the nipple is classified by most dermatologists under epitheliomatosis or carcinoma of the skin. It is like superficial epithelioma, the onset is slow and the condition suggests an eczematous involvement of the areola of the nipple. The process begins with a moderate inflammation exhibited as redness and scaling involving the nipple areola. Murphy called attention very forcibly in the *Year's Progress of Medicine and Surgery*, 1915, that Paget's disease is cancer from the very first, and that even in the early cases there was a mortality of over 90 per cent. of cases even when submitted to surgical operation. I have treated cases of Paget's disease by radiation alone and have patients clinically cured for over ten years. This corresponds with the experience of many others. The treatment should consist in radiation not only applied locally, but the adjacent glands should be treated as thoroughly as it is given postoperatively for carcinoma of the breast. If these cases are treated early, when there is only the eczematous condition present, and treated thoroughly, the results are rather uniform. It is to be remembered in all cases there is no attempt at repair, and, when abandoned to its course, the ultimate result is a profound ulceration with the destructive effects most noticeable in the region of primary invasion, the entire breast becomes cancerous and invades the lymphatics. It is to be remembered that local treatment suggested for eczema has no effect on this condition.

CEREBRAL HEMORRHAGE OF THE NEWBORN.

BY MARGARET WARWICK, M.D.,
MINNEAPOLIS, MINNESOTA.

(From the Department of Pathology, University of Minnesota, Minneapolis.)

SINCE earliest times the traumatism undergone by an infant during the process of birth has been recognized and deplored. This is, of course, especially marked in long or difficult labors, and we have become only too familiar with the severe injuries which may result

from this cause. The most common of these has been naturally head injury, associated with hemorrhages which often have been considered as a cause of stillbirth or death during the first few days of life. But, although recognized as a theory, on reviewing the literature one finds very few statistics founded upon detailed autopsy reports in cases of cerebral hemorrhage of the newborn. Although a subject of vital interest and fundamental importance to the obstetrician, pediatrician and pathologist it seems to belong to none and to be neglected by all.

Little, in 1861, was the first to emphasize birth injuries, and their results in later life, as shown by the development of impaired mentality or the palsies or contractures in older childhood. But as at that time the effects of pressure on the cortex was but imperfectly understood, it was left to Sarah McNutt, in 1885, to establish the relationship between cerebral hemorrhage at birth and Little's disease of later life. This was done by autopsy reports on 10 carefully studied cases. Of these 10, 7 were vertex and 3 breech presentations, showing that prolonged pressure on the head is not always responsible for the condition. Of the 7 vertex presentations 5 showed hemorrhage over the cerebrum and 2 below the tentorium. The hemorrhage in the breech presentations was over the cerebrum in all 3.

Of the occurrence of cerebral hemorrhage as compared with other causes of death in infants only meager information is found. Holt says that one-third of all deaths during or as the result of parturition are due to hemorrhage, but gives no exact numbers based on autopsy findings. Cushing found that in studying stillborn infants for another purpose, many showed cerebral hemorrhage. From the Pathological Institute of Kiel, Weyhe reported that in 959 autopsies on infants 122, or 12 per cent., showed intracranial hemorrhage. In 80 of these cases the hemorrhage was subdural, in 56 subarachnoidal, in 35 intracerebral and in 21 intraventricular. Of these 122 cases 23 showed evidence of congenital syphilis. Döhle found hemorrhages occurring in 13.7 per cent. of his series. Beneke observed in 100 autopsies on the newborn laceration of the tentorium resulting in hemorrhage in 14 cases. Osler quotes Litzmann as finding 35 cases of hemorrhage in 161 autopsies, Parrot as noticing bleeding in the subdural space 26 times in 34 autopsies of the newborn and Spencer finding in 130 postmortem examinations on stillborn infants 53 cases with hemorrhage under the pia-arachnoid. Sachs in autopsies on 78 cases of infantile hemiplegias noticed hemorrhage in 23. Couvelaire saw intracranial bleeding in 18 per cent. of autopsies on prematures born with easy and spontaneous labors. Archibald reports in 74 postmortem examinations that intermeningeal hemorrhage occurred in 32, and this hemorrhage was extensive in 19 and extradural in 5.

Isolated cases confirmed at the autopsy table are quite numerous

in the recent literature, especially since Cushing's article describing operative procedure for the relief of the condition. Green describes 1 with blood over both hemispheres and at the base along the crura and pons, 1 other with clots over the right hemispheres and 2 more with bleeding over the cerebrum accompanied by hemorrhages in other organs. Eastman reports 1 case with bleeding in both ventricles. Torbert had 2 cases, both with hemorrhage over the cerebrum. Simmons saw 2 cases with the same distribution. Others are given by Cushing and Meara and Taylor.

Every pathologist familiar with autopsies on the newborn has noticed, even without massive bleeding in any organ, numerous small punctate hemorrhages occurring especially over the epicardium and the parietal pleura. Paul finds these same hemorrhages in the retinae of the newborn during life. In 200 examinations he noted hemorrhage in the retina in 20 per cent. of children born with a normal labor, 50 per cent. of prematures and 40 per cent. of those from complicated and prolonged labors. In view of these findings the assumption is justifiable that young infants' bloodvessels are particularly delicate and susceptible to rupture from injury.

As to the etiology of these hemorrhages one finds as many theories suggested and advanced as there are authors. All agree, however, that the condition is as frequent in cases of normal or precipitate delivery as in difficult labors. It has also been shown that hemorrhage may occur even before birth. Gibb reports a child born with contractures of one arm and leg and an old blood clot above the lateral ventricle, while the mother gave a history of trauma. Osler found in an autopsy on a woman dying of typhoid in the seventh month of pregnancy a fetus containing a large hemorrhage in the brain. Seitz quotes another case in which a macerated fetus delivered spontaneously had a hematoma the size of a walnut in the brain hemisphere.

Kreyberg thinks that a long time elapsing between the birth of the head and shoulders is an etiological factor, while La Letra states that hemorrhage frequently follows asphyxia caused by the cord being twined about the neck. Benthin suggests that it may be caused by too great pressure on the perineum. Beneke points out that during severe labor pains the pressure is often on the sides of the head, increasing its long axis, pressing the brain forcibly against the tentorium and causing tearing of its radiating fibers. He further explains that this tear may be of the anterior, posterior or middle layer, and therefore may cause bleeding over either the cerebrum or cerebellum. But Seitz, after a careful study in which he cut serial sections of the head and its contained brain, concluded that although one-half of his cases confirmed Beneke's theory the other one-half excluded tentorium injuries as a cause and pointed instead to injuries of the vessels over the brain. He therefore groups all of these cerebral hemorrhages into three divisions: (1) hemorrhage

over the cerebrum (one or both hemispheres) from injury to the longitudinal sinus or the vessels emptying into it; (2) hemorrhage under the tentorium around the cerebellum, due to injuries to the transverse sinus or tributary vessels; (3) hemorrhage into the lateral or fourth ventricles, due to the tearing of the veins of the choroid plexus. The last group is evidence against the theory of tentorium injury being the only cause of cerebral bleeding.

Abels places the causes under two groups: (1) Tearing of the vessels due to molding of the head in such cases, as contracted pelvis, forceps deliveries, etc.; (2) backing up of the blood in the sinuses and veins in asphyxia. He points out that during labor the pressure on the fetus is raised in the uterus, and especially before the membranes are ruptured, is evenly distributed, thus causing no congestion or stasis of the blood in the child's head. But when the head is born it is released from the uterine pressure still acting on the body, and the result is a marked congestion or stasis of the bloodvessels of the head. Since the skull cannot expand to any marked degree the delicate-walled veins on the surface of the brain may become extremely engorged and often rupture. The sutures permit of some expansion, and Abels thinks that this is the reason hemorrhage is rarely found in the neighborhood of the sutures.

Cushing adopts the same classification as Abels and says that rupture may be possible in marked asphyxia, just as it may be possible in later life in a paroxysm of whooping-cough or a convulsion. He also notes the frequency of rupture of the veins at the point of entrance into the longitudinal sinus and points out that in infants there are no adhesions between the dura and cerebral hemispheres, thus leaving these veins unprotected and in a position to be easily displaced or torn by the overriding of the parietal bones during the molding of the head.

Seitz made an effort to find the etiology of cerebral hemorrhage in the newborn by making a careful analysis of the 13 cases which came under his observation. Of these infants he found 5 to be below and 8 above average weight, suggesting oversize as a possible etiological factor. Of the 13 mothers 7 were primipara, and of these 4 were over thirty years of age; 6 were multipara, and of these 4 had borne many children. One-fourth of the mothers had a contracted pelvis, but in none was it marked. Of the 13 deliveries forceps were used 10 times, leaving only 3 spontaneous births; 11 of the 13 babies were born asphyxiated, 5 to a mild degree and 6 to a marked degree. However, of the 3 unaided deliveries 2 breathed spontaneously, all 3 mothers were multipara, none had narrow pelves, none had lues, the births were all rapid and the cervixes all quickly and completely dilated. In view of these facts the explanation of the occurrence of the hemorrhages becomes exceedingly difficult or obscure. But all three babies were large, so Seitz reaches the con-

clusion that although dilatation appeared complete it was not sufficient for children so large, and in the rapid delivery the head was too quickly molded and injury to the veins was the result.

All authors agree on the predominance of bleeding over the cerebrum, usually limited to one side. It is also frequently pointed out that the child may appear normal for the first few days and then develop cerebral symptoms. Kundrat thinks that many of these infants recover from hemorrhage resulting from birth trauma without developing any symptoms, for in autopsies on children several weeks old he has found old pigment in the meninges and other signs of old extravasated blood. Meara and Taylor warn against "jack-knifing" as a means of artificial respiration, on the ground that it increases the distention of the cerebral vessels already engorged by the asphyxia. This assumption is given greater weight by the occasional discovery of subdural and extradural hemorrhage in the spinal column following such manipulations. But to Green belongs the credit of first suggesting hemorrhagic disease of the newborn as a cause of cerebral hemorrhage.

In the pediatrics service at the University Hospital during the last three years 36 routine autopsies have been performed on still-born babies or those dying early in infancy. In this series 18, or 50 per cent., showed definite hemorrhages in the dura, over the brain or in the ventricles. Of the 18, 10 occurred in females and 8 in males. If one takes Seitz's figure of 3200 grams as the average weight of a full-term child, of our 18 cases 11 were of average weight or below and only 7 above. Of the 18 mothers 11 were primiparæ of these 11 only 1 was over thirty years, 1 was twenty-nine and the remaining 9 were twenty-four or under. Of the 7 multiparæ 2 were second labors, 1 was third, 1 was fourth, 1 was fifth, 1 was eighth and 1 was ninth. Forceps were used but once, and then in the case of delivering a mother, critically ill with pneumonia, of a six months' fetus. In only 2 cases was the labor very long, and in both of these cases twins were born, in each instance the first one remaining normal while the second showed cerebral hemorrhage. Of the 18 babies only 2 were born dead and 4 exhibited signs of asphyxiation, while the remaining 12 breathed spontaneously, thus excluding mechanical asphyxia as a major factor in this condition. Only 2 infants appeared normal at and following birth, the others showing respiratory symptoms from the very first.

One very interesting point, however, is that in 8 of these infants gross hemorrhages were found in other organs besides the brain. It thus appears quite clear that in a fairly large percentage of cases showing intracranial hemorrhage such lesions are merely incidental to a general hemorrhagic diathesis, the syndrome being usually grouped under the heading, "Hemorrhagic Disease of the Newborn." Five of the 8 vomited blood before death and showed an increased coagulation-time of the blood. Of the 3 remaining cases without

clinical symptoms I revealed besides the hemorrhage over the brain an extravasation of blood into the right adrenal, another, massive hemorrhages in the lungs and the third hemorrhages in the pericardium and skin. These facts emphasize the value of routine estimations of the coagulation-time on the blood of newborn infants. Early recognition of decreased coagulability of the blood and prompt treatment of such cases by the injection of whole blood or serum might obviate otherwise fatal hemorrhages in the brain as well as other organs. Of the two small twins each born alive after its fellow the condition cannot be explained on the ground of overweight or of only partially dilated cervix, but one showed massive hemorrhage in the lungs as well as over the brain and the other was definitely, clinically and anatomically hemorrhagic disease.

Kundrat points out that partial atelectasis of the lungs is always associated with cerebral hemorrhage and is almost pathognomonic of it. While our necropsy findings show that the two conditions are associated, atelectasis of varying degrees was also found in infants not showing cerebral hemorrhage. Hence, as partial atelectasis may be explained by the short period of life, asphyxiation or prematurity, it may be considered as, at the most, merely a contributory and not as a primary condition.

The location of the hemorrhages of the series of cases from the University Hospital conforms well with other observations given above. In this series hemorrhage over the cerebrum and limited to one hemisphere occurred six times; over the cerebrum, cerebellum and in the dura three times; over the cerebrum, cerebellum and in the ventricle once; over the cerebrum and cerebellum three times; over the cerebellum once; in the dura alone only twice; and in the ventricles alone twice. Hemorrhage over the cerebrum either alone or with other parts of the brain is found in a total of 13 cases, or 72 per cent. In only 2 cases was softening of the brain under the hemorrhage noted, and this occurred in the oldest in the series, an infant of five days, and in a premature one month of age. In the other cases doubtless death occurred before degenerative changes could take place in the brain substance. In no case was gross hemorrhage into the brain substance found. None of these infants showed any signs of congenital syphilis, and only one mother gave a positive Wassermann reaction. Only four were born prematurely. The high percentage of hemorrhages in these cases may be partially due to the fact that very few emergency or acutely ill patients are admitted to the University Hospital, so that the list therefore includes few acute diseases of either mothers or infants and is limited to births occurring in the hospital.

When confronted by the resumé of the literature and the analysis of the cases give above, one is impressed by the comparative frequency of occurrence of cerebral hemorrhage in newborn infants and also by the number and confusion of the etiological factors

claiming attention. A classification of the various causes which have been proposed will emphasize this latter fact and also form a basis for a discussion of their relative merits. They may readily be divided into three main groups:

I. Traumatic: from molding the head, either in normal or precipitate deliveries.

1. Over the cerebrum:

(a) Due to injury of the longitudinal sinus or its tributary vessels.

2. Below the tentorium:

(a) Due to injury of the transverse sinus or its tributary vessels.

3. In the ventricles:

(a) Due to injury of the choroid plexus.

4. In the dura.

(a) Due to elongation of the head with pressure of brain against dura and tentorium.

II. Congestion or stasis with rupture of veins in protracted or complicated labor due to:

1. Malpresentations.

2. Overgrowth of child.

3. Twins.

4. Umbilical cord around neck.

5. Rigid cervixes in primipara.

6. Prolongation of the interval between the birth of the head and that of the shoulders.

III. A diseased condition of the child in intra-uterine life and having no relationship to labor, such as:

1. Hemorrhagic disease of the newborn.

2. Prematurity.

3. Syphilis.

4. Congenital heart disease.

5. Other toxemias.

Considering the subject as a whole it becomes ~~at once clear that~~ the most frequent source of this bleeding, regardless of cause, is rupture of the superficial veins which pass over the surface of the brain into the longitudinal sinus. This may be explained by the fact that these veins are in a comparatively unprotected position, and hence more susceptible to injury from either displacement or abnormal distention. Of all vessels in the body these are the ones most exposed to the injuries and accidents of labor and birth.

The first division of the above classification represents, theoretically at least, one of the most common causes of injury, *i. e.*, overriding of the parietal bones and resulting displacement and laceration of the veins. For this condition even an abnormal labor is not necessary, and it frequently is most marked in normal deliveries, especially those which are rapid or precipitate. In fact, the more

rapid the delivery the less chance do the brain and vessels have to adjust themselves to the changed relationships and the greater tendency there is to injury. This point is emphasized in the 18 cases cited above in which only 2 showed a prolonged labor. In the overriding of the parietal bones the condition is naturally the most marked on one or the other side, and as a result the hemorrhage is frequently limited to one cerebral hemisphere, as was noted in 6 cases of our series. Of less moment, perhaps, but following the same principles, the changes in the relation of the occipital bone to the parietals may account for hemorrhages over the cerebellum, and perhaps in certain cases even those originating from rupture of the choroid plexuses. The hemorrhages in the dura only may be accounted for by injury to the tentorium or dura, either by laceration of their fibers or of their capillaries in the twisting or elongation to which the head is subjected in its passage through the birth canal. The use of forceps is often advanced as an explanation of these hemorrhages, but one finds in the 18 cases analyzed above that forceps were employed but once, and then in a very easy delivery. There is little doubt that this factor has been greatly overemphasized. Their usual position in this category may be due to a confusion of the ideas of cause and effect. The harm is doubtless done in many instances not by the mechanical injury of the forceps themselves, but by congestion or asphyxiation due to the protracted or complicated labor which caused the attempt at artificial aid to delivery.

The second group includes those cases in which labor is prolonged and the resulting congestion and overdistention of the veins lead directly to hemorrhage or indirectly to rapid degeneration and subsequent rupture, just as in later life undue dilatation of a cerebral vessel may result from a paroxysm of whooping-cough or a convulsion. Narrow pelves, malpresentations or an abnormally large child are self-explanatory factors in producing mechanical obstruction to normal birth of the infant. The constriction of the neck by encircling with the umbilical cord is also a fairly common cause of asphyxiation. A long time elapsing between the birth of the head and that of the shoulders may result in a marked congestion of the cerebral veins, due to the fact that while the head is free the body is still subjected to uterine pressure and the blood is forced out of the body into the head. In the case of twins the first child may be normal while the second, even though delivered quickly, will show marked congestion because of too long delay in birth. In respect to primipara it is interesting to note that in the cases above cerebral hemorrhage occurred more frequently in young primipara mothers than in older ones. The difficulty here is doubtless due to rigidity of the cervix, with resulting slow and imperfect dilatation in the first labor, and this occurs in young as well as older women.

In the third group of cases the cause of the hemorrhage undoubtedly is in the fetus and has little or no relationship to the process of

labor itself or the conditions accompanying birth. In this division hemorrhagic disease of the newborn deserves by far the most important place because of the comparatively large number of deaths with cerebral hemorrhage showing this condition. It accounts for the death of 8 of the 36 cases in our series. One is justified in emphasizing the importance of this disease because of the fact that it has been largely disregarded in the past. Prematurity, while not an actual disease, is placed here because it represents a pathological condition of the child rather than of the mode of birth. Underdevelopment of the body as a whole naturally includes abnormally delicate bloodvessel walls and hence greater liability to rupture from any cause. Moreover, the conditions which have produced a premature birth are often those which have also brought about pathological changes in the tissues, including the bloodvessels, and this has increased the possibility of accident. It is important to note in this connection that nearly one-fourth of the autopsies in our series of cerebral hemorrhages were on premature infants.

Syphilis is perhaps given undue importance as an etiological factor. In none of the 18 cases of our series was there any evidence of this disease. Weyhe claims a place for it, and the importance of syphilitic degeneration of the vessel walls cannot be denied as a possible cause of early rupture. As a rule, however, the disease itself usually accounts for the death of the child and cerebral hemorrhages do not appear to be a common complication. The influence of congenital heart disease, particularly those forms which interfere with the development of a normal extra-uterine circulation and the resulting abnormal congestion thus produced, is a self-evident cause of the occasional appearance of complicating and intracranial hemorrhage. This point is well illustrated in one of our series in which the heart presented an absence of the interventricular septum, and from this common ventricle only one arterial trunk carried away the blood destined for both pulmonary and systemic circulation, the mixture of which must unavoidably lead to profound asphyxiation.

Lastly under this heading must be placed certain cases in which the exact cause of the hemorrhage is by no means clear but in which a diverse group of intoxications occurring in the mother may reasonably be assumed as having an important relation to antenatal degeneration and weakening of the vessel walls. An example of this was, in our series, the small six months' fetus, quickly delivered from a mother dying of lobar pneumonia, which showed marked cerebral hemorrhage.

In conclusion, a general consideration of cerebral hemorrhage in newborn infants emphasizes two very important facts: (1) that the condition is often a complex disease syndrome giving rise to diverse clinical symptoms, modes of death and pathological findings, and (2) that it is not brought about by any single cause but by an inter-

relation and interaction of a varying number of causes which may be found in the circumstances governing labor in the condition of the mother or of the child. Several causes may often be present, any one of which in itself might have been the responsible factor.

SUMMARY. 1. Cerebral hemorrhage of the newborn is frequently found, occurring in 50 per cent. of 36 deaths of young infants at the University Hospital.

2. The condition is brought about by trauma in normal or rapid deliveries, by congestion or asphyxiation in slow deliveries or by disease of the child itself.

3. The so-called "hemorrhagic disease of the newborn" is a much neglected but very important cause of cerebral hemorrhage in infants, occurring in 44 per cent. of the deaths of our series.

4. Forceps deliveries, advanced age of the primipara mother and syphilis probably do not play as important a role in the etiology of this condition as was formerly supposed.

5. More careful and complete routine autopsies on newborn infants as well as more accurate observations on the conditions of the mothers and circumstances of the birth are needed as a foundation for further studies.

I am indebted to the department of pediatrics for obtaining permission for these autopsies and to the department of obstetrics for their careful records on their parturition charts.

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PNEUMOXYDROTHORAX.¹

By JAMES I. JOHNSTON, M.D., F.A.C.P.,

ASSISTANT PROFESSOR OF MEDICINE, UNIVERSITY OF PITTSBURGH; PHYSICIAN TO THE
MERCY HOSPITAL, PITTSBURGH, PA.

THE teaching clinician of two decades ago found in pneumohydrothorax an opportunity for one of his finest demonstrations of pulmonary physical signs. Da Costa and Musser, without thoracic roentgen-ray aid, presented the striking signs of this condition with great exactness; but we, their pupils, seem to have either forgotten this result of pathological destruction to the lungs, or else pneumohydrothorax is not so common as formerly. This latter view one cannot but feel is possibly true, and for two reasons: (1) due to the elaborated work on tuberculosis, early infections are recognized, patients are brought to a state of cure and saved in great numbers from the late stages of pulmonary destruction; (2) those cases that do go on to advanced pulmonary disease receive better care in the cavity stage. It is generally accepted that 90 per cent. of all cases of pneumohydrothorax are due to advanced pulmonary tuberculosis. One cannot but pause here to emphasize again what most progressive internists still stand for, namely, that physical signs are of the first importance and their interpretation of the utmost value, even with our plates, fluoroscope and laboratory studies, desirable as they are and useful as adjuncts. Pneumohydrothorax is a conspicuous example of this.

Hoover called the attention of the Interurban Clinical Society some years ago to a sign in thoracic diseases which impressed us very much and which, like him, we continue to teach our students. This sign, simple in itself and easy of application, shows well the movement of the diaphragm, and is far superior to and easier of demonstration than either the so-called Litten's diaphragm phenomenon or possibly the fluoroscope. We have never seen this sign explained in print, but if not recorded it well deserves to be so placed. The diagnostician

¹ Read before the Allegheny County Medical Society, April 16, 1919.

places his two thumbs at the most prominent parts of the sides of the thoracic costal angle, usually where the ninth rib joins by its cartilage the sternum, with the rest of each hand enfolding the sides of the lower thorax on either side. The excursions of respiration exaggerated by the patient, when possible, allow the movements of the thumbs to be studied, whether outwardly, even, equal or actually drawn in toward the middle line. The findings from this observation show any interference of the diaphragmatic range, if present, and point to the side of thoracic pathology, whether from pain, fluid, consolidation or adhesion. In our cases of pneumohydrothorax this sign was marked, and in all our chest work it is exceedingly valuable. One other sign must be mentioned here, which is frequently if not commonly misunderstood, and for the recent emphasis of which credit is also due to Hoover. This was also marked in our cases of this condition, namely, the presence of bronchial breathing, heard best by the ear next to the naked chest. Such bronchial breathing is always heard over pleural effusions as well as over consolidations, a fact usually disassociated in the average physician's mind because of the idea of the intervention of another medium between the lungs and the parietal pleura.

Assuming as correct that 90 per cent. of cases of this pathological entity are due to previously established pulmonary tuberculosis, such a history of previous infection and often of pulmonary destruction must be given great weight; but more striking is the history of a sudden pulmonary accident occurring in such cases. Both of our recent cases due to tuberculosis gave a history of sudden pulmonary pain and distress accompanied by sudden orthopnea and cyanosis definitely fixed, and both were cases from sanatoria for pulmonary tuberculosis in a state of presumptive benefit and quiet. The pathognomonic signs of amphoric breathing, unilateral basic impaired resonance, tinkle, coin test, succussion splash, etc., are well known and need no repetition here. Suffice to say that they were all present in the cases forming the bases of this paper, and should patients survive the initial stormy onset, are usually found. The prognosis is an important element; a very small percentage are said to recover, although most patients live for a few weeks following the pulmonary rupture. This was true in our cases. A fatal outcome and in a short period is the proper stand to take. We were able to make a roentgen-ray study of one of these cases, and the plates clearly revealed the facts which the carefully worked-out physical signs and history had already impressed upon us. A fluoroscopic study, when possible, would be an attractive confirmation, and, we think, of the greatest value.

The first of our cases, seen in a small town in consultation, presented the picture of orthopneic distress with great cyanosis, which had been present for two weeks. The history was that of sanatorium residence, allowed home in a state of non-activity

and then of a sudden pulmonary accident, followed immediately by great dyspnea and cyanosis, attributed at the time to acute infective tubercular pleuritis. A consultant of skilled ability saw this patient some time later, put a needle low in the thorax on that side, diagnosed pleural effusion, and agreeing with the acute pleuritic infective view, advised aspiration. This patient, when seen by us, had all the signs of pneumohydrothorax. The physicians had gotten their needle into the hydro part of the resultant pathological accident and were misled. The operation of paracentesis thoracica was advised against by us and a bad prognosis was given the parents of the patient, both as to outcome and time, and our opinion proved correct.

The second patient, at the time of the pulmonary accident, was in a sanatorium, where she had been for eighteen months. The condition at its occurrence was diagnosed as acute cardiac failure, and she was expected to die at the time, which patients sometimes do at the onset of pneumohydrothorax. Her case was almost a replica of the one already reported, except that the physician in attendance insisted upon the heart insufficiency, and after a month sent her home, expecting a fatal termination from the cardia. She showed the classical signs of pneumohydrothorax, and the roentgen-ray plates not only confirmed our physical signs, but showed well how the patient literally was using only part of a lung, and that on the supposed normal side. Her cyanosis, which was extreme, was due to lack of lung space purely. The same prognosis, as to result and time, given in the former case was stated and was right.

It is possible that we are too greatly impressed by our recent experience, but we think not. The aforesaid consultant in the first case, skilled as he is particularly in pulmonary tuberculosis, would hardly have missed a common thing. Our own chest work makes us think that pneumohydrothorax is uncommon. On the other hand, it is possible that symptoms attributed to the cardia in late pulmonary tuberculosis belong here, as shown in one of our cases. This would mean that the condition, if common, usually goes unrecognized. One of my colleagues recently reported to me a case of this pathology following acute pneumonia, with death. It also occurs occasionally in early pulmonary tuberculosis. Our impressions are that pneumohydrothorax is rarer than formerly; that the prognosis is exceedingly bad; that like other complications of disease it is not recognized because not borne in mind and hence not looked for; and, finally, that little or nothing can be done for its correction or alleviation at present.

REVIEWS

SURGICAL APPLIED ANATOMY. By SIR FREDERICK TREVES, Consulting Surgeon to the London Hospital. Seventh edition, revised by ARTHUR KEITH, Hunterian Professor, Royal College of Surgeons of England, and W. COLIN MACKENZIE. Pp. 702; 153 figures, including 74 in colors. Philadelphia and New York: Lea & Febiger.

THIS compact little volume is so well known that no extended account of its scope and contents is necessary. As soon as the medical student has gained his first acquaintance with parts of the human body, such a book as this is very useful to him. In its method of presentation of anatomical facts it crosscuts the other methods. Like a beam of light from a searchlight it throws into prominent view certain structures in such a way that a vivid impression remains. In understanding these structures, one must know their relation and the adjoining parts as they are learned in an anatomical laboratory. But after all these are learned there comes the question of how much is to be retained, and there is no doubt that what is made use of in practice is the part that remains. An applied anatomy points out what these parts are, and is therefore helpful in directing the student's activities in a more or less definite direction. In the present edition the text has been revised to some extent with regard to the needs of war surgery. There has been added what the editors term "orthopedic anatomy," the kind of knowledge that is necessary for the successful treatment of stiffened joints and disabled limbs. Twenty-seven new illustrations have been added. These and other changes all tend to keep the book on the plane which it has long maintained.

W. H. F. A.

MILITARY SURGERY OF THE EAR, NOSE AND THROAT. By HANNAU W. LOEB, M.D., MAJOR, M.R.C., U.S.A., St. Louis, Mo. Medical War Manual No. 8; Authorized by the Secretary of War and under the Supervision of the Surgeon-General. Philadelphia and New York: Lea & Febiger.

THIS manual has been especially prepared for the use of the nose, throat and ear specialists of the army and navy, and as the commis-

sioned otolaryngologists are presumably well grounded in the fundamentals, no attempt has been made to present elementary principles and practice.

Each chapter is divided into two portions. The first portion is an expression of the writer's opinion of the pathology, etiology, symptomatology, treatment, etc., of the various injuries and diseases of the ear, nose and throat. The second portion, under the heading "Comment," contains short abstracts, pertinent to the subject under discussion, garnered from the war literature published in England, America, France, Italy and Germany.

This little book really covers in a very creditable and comprehensive manner all of the special conditions which the otolaryngologist is liable to meet with in his military experience. The chapter on malingering will be found especially useful to the medical examiner. The chapter on ear and aviation is a reprint of an article published by Major I. H. Jones. The literature consulted by the writer of this manual has been very extensive, and chapter 17, consisting of thirty pages, is a very useful reference book of literature on this subject. Reconstruction and reëducation receive a commendable amount of attention. Although there are no illustrations, the text is sufficiently clear and comprehensive to enable the otolaryngologist to obtain a good working knowledge of the special war feature of diseases of the ear, nose and throat. G. B. W.

NEUROLOGICAL CLINICS: EXERCISES IN THE DIAGNOSIS OF DISEASES OF THE NERVOUS SYSTEM. Edited by JOSEPH COLLINS, M.D., New York. Pp. 271; 3 illustrations. New York: Paul B. Hoeber.

THIS is the first volume of case reports to be published by the staff of the Neurological Institute of New York. In it forty-one clinical cases or groups of cases, selected from those presented at the bi-weekly conferences of the staff, are discussed. These include a wide variety of neurological topics, such as cerebellopontine angle tumors, progressive hemiplegia, cerebral syphilis, gliosis of the spinal cord, hydromyelia and recent methods for recognition of the different types of hydrocephalus. A chapter is devoted to each topic and in each the essential points are brought out in a clear, straightforward manner, the average length of a chapter being five to seven pages. The method used is first to delineate the important symptoms, then discuss the interpretation of these symptoms and finally to arrive at a diagnosis. The manner in which this has been carried out should be very helpful not only to general practitioners, but also to those whose chief interest is in diseases of the nervous system. W. A.

A TEXT-BOOK OF PATHOLOGY. By FRANCIS DELAFIELD and T. MITCHELL PRUDDEN. Eleventh edition revised by FRANCIS CARTER WOOD, M.D., Director of the Pathological Department, St. Luke's Hospital, New York; Director of Cancer Research, Columbia University, New York. Pp. 1243; 15 full-page plates and 809 illustrations in black and colors. New York: William Wood & Co., 1919.

THIS book, which has been known so long and favorably, appears in this edition as a considerably rejuvenated volume. The general arrangement remains the same as in former editions, thus assuring the physician and student of a reference work in which information is readily obtainable. This same fact assures the teacher of having in the hands of his students a book which can be consulted with little loss of time in searching for desired information. The scope of the book remains the same, including a chapter on pathological methods, brief, it is true, but containing the essentials of the subject.

The text of the book has been almost entirely rewritten and many new illustrations inserted. The chapters on tumors, urinary organs, reproductive organs of the female and bones and joints have undergone most complete revision, that on tumors showing the skilful and accurate exposition of the subject to be expected of the revising editor. Only favorable comment can be made on the revision of the text, but many old illustrations remain, and it is unfortunate that the illustrations could not have received the same extensive revision as the text.

The preface states that certain considerations of functional pathology have been admitted to the book, but indicates that a larger consideration of this phase of pathology finds its proper place in a text-book of medicine. There is room for argument in regard to this proposition, and the reviewer recognizes the limitations of space imposed by the practical necessity of publishing a book on pathology in one volume; but, nevertheless, the modern teaching of the subject involves so much instruction in alterations of function as associated with alterations in morphology that the more or less perfunctory discussions given in this book restrict its usefulness as a manual for students. The discussion of valvular lesions of the heart is particularly weak in this respect. Features of this sort are more or less compensated for by the excellent descriptions of the morbid anatomy and histology of various lesions, but even here deficiencies are noted, as, for example, in the description of syphilitic arteritis and also in tuberculosis of the lungs, where a beautiful illustration (Plate VIII) of peribronchial tuberculosis is called miliary tuberculosis.

A most valuable feature of the new edition is the list of references to important articles, monographs and books on subjects under discussion. These are carefully selected and the references accur-

ately given. There are only occasional deficiencies, which may represent deliberate omissions on the part of the editor. The reviewer, however, feels that the list of references to modern work on diabetes mellitus should include F. M. Allen's book.

The general impression created by the new edition is most favorable, and, considering the limitations placed by necessity on revision of an authoritative and standard book, the result is highly creditable. It is to be hoped that further revision will result in greater modernization, and there is no doubt that this will be true in the hands of the same editor. The book is mechanically excellent, and if the few criticisms recited above are reserved, the book can be very highly recommended to physicians, teachers and students as a valuable book for general purposes, and one which, by virtue of text, illustrations and references, presents the subject of pathology in clear, comprehensive and modern fashion. H. T. K.

THE OPERATIVE TREATMENT OF CHRONIC INTESTINAL STASIS.

By SIR W. ARBUTHNOT LANE, BART., C.B., Consulting Surgeon to Guy's Hospital. Fourth edition, revised and enlarged. Pp. 328; 133 illustrations. London: Oxford University Press.

THE fourth edition of this monograph appears as a larger volume than any of its predecessors. There is practically no change in any of the material that has appeared in previous editions, but the present volume contains over 100 pages of entirely new matter representing contributions from nine other men who are in complete accord with the gospel as preached by Sir Arbuthnot Lane. These new contributors are men well known in their respective lines of work, and their opinions and writings are based upon the relationship of intestinal stasis to their special fields of investigation. In this manner the subject is considered from the viewpoint of the anatomist, pathologist, hematologist, ophthalmologist, clinician, bacteriologist, roentgenologist, gynecologist, and dentist, and it is a great tribute to Mr. Lane's work to note the unanimity of workers in such divergent specialties regarding the importance of intestinal stasis. Apparently the author has lost none of the enthusiasm that he exhibited in his earlier publications, and his associates are equally enthusiastic regarding his tenets; but such a statement as "All disease of what kind soever is due to intestinal stasis or cognate conditions," coming from the pen of Williams, must certainly be regarded as the opinion of an extremist and will not be taken seriously by the average reader. Aside from such a statement, however, Williams's contribution is one of the best of the new additions to the book, as it is very interesting, most entertaining

and at times logical. It is indeed fascinating to see how these authors can trace practically any morbid state to an underlying intestinal stasis, but in spite of the sincerity of their work it will be difficult to win the profession, of this country at least, to their belief. Typographical errors are more frequent than would be expected, but in other respects the book is quite attractive. F. B. B.

THE NEWER KNOWLEDGE OF NUTRITION. THE USE OF FOOD FOR THE PRESERVATION OF VITALITY AND HEALTH. By E. V. McCOLLUM, School of Hygiene and Public Health, Johns Hopkins University. Pp. 199; 11 figures and 16 charts. New York: Macmillan Company.

THE author is one of those who have added to our knowledge of nutrition in the last decade. In this little volume he gives an interesting account of some of these advances in our knowledge, of how they have been arrived at and of how they are applied in our daily life. From this last point of view the book should appeal not only to the physician but also to the physician's wife. Most of the information in this book was presented recently as the Thomas Clarence Cutter lectures at the Harvard Medical School. These lectures have been edited and are now presented in a form which should have a wide circulation. The method of experimentation has been that of feeding to animals simplified diets of various purified foodstuffs, singly and in combination, in order to find out those substances which would promote growth and those inadequate to produce growth or even to sustain life. In this way two dietary essentials have been discovered. They are known as fat-soluble A and water-soluble B. The former exist in butter-fat, eggs and leaves of certain plants, and photographs of animals show the great difference which the addition of a small amount of one of these substances to an imperfect diet makes in the condition of the animal. The vegetable fats and oils, such as olive oil and cotton-seed oil, do not furnish this dietary essential. This method of seeing the results by feeding to the living animal is termed the "biological" analysis of foodstuffs in contradistinction to the method of studying nutrition values by chemical means. The one is needed evidently to supplement the other. The diseases due to faulty diets, such as beriberi, xerophthalmia, pellagra, scurvy, rickets are discussed at some length, and the author gives his views as to the dietary deficiencies or imperfections which are responsible for them. In the chapter on the planning of the diet, the various results arrived at are applied directly toward pointing out the direction in which our dietary habits should be trained, and great emphasis is put upon the inclusion of "protective foods," such as milk, eggs and leafy vegetables. W. A.

THE EARLY TREATMENT OF WAR WOUNDS. By COL. H. M. W. GRAY, C.B., C.M.G., M.B., F.R.C.S., Consultant in Special Military Surgery. Pp. 300; 25 illustrations. London: Henry Frowde and Hodder & Stoughton, 1919.

EMINENTLY qualified by long experience as consultant surgeon in France with the British Expeditionary Force, Col. Gray has written this book for surgeons preparing to undertake new problems under conditions that afford little opportunity for extensive reading. Most of the chapters, in a somewhat different form, have been published in the *New York Medical Journal*. The author describes the emergency treatment of wounded men in advanced areas, the measures that have reduced mortality due to transportation, and particularly the operative treatment necessarily carried out in the casualty clearing stations. Abdominal work is omitted from the chapters on regional surgery. The author emphasizes vital points in forceful style and keeps in mind the ideals to be sought. The illustrations are confined almost entirely to apparatus not well known in civil practice. Though not claiming too much for anti-septics in general, he advocates the use of some of the newer agents that did not attain popularity in the U. S. Army. The book also well illustrates the scope of work done by the sanitary trains and evacuation hospitals of the American Expeditionary Forces, and will prove of special interest to the thousands of physicians who did not realize their hopes for service at the Front.

G. M. L.

RADIODIAGNOSIS OF PLEUROPULMONARY AFFECTIONS. By F. BARJON. Translated by JAMES A. HONEIJ, M.D., Assistant Professor of Medicine in Charge of Radiography, Yale Medical School. Pp. 183; 27 drawings and 54 reproductions from roentgenograms. New York and New Haven: Yale University Press.

THIS book is a valuable contribution to collective roentgen literature on chest diagnosis and one which can be recommended to the roentgenologist for reference and study. The time has arrived when it is essential that the internist and the surgeon keep in touch with the advances that have been made in roentgen diagnosis of intrathoracic conditions, and this work offers an exceptional opportunity for demonstrating the possibilities of roentgen examinations and what should be expected from them. It is concise and dependable, though possibly not so systematic in arrangement as one would wish.

The first section describes the methods of examining by the fluoroscope and what information may be expected by this means. As with most continental writers, fluoroscopic studies have been

used to a greater extent and have been depended upon more than is the case with American roentgenologists.

The second section deals with the diagnosis of conditions of the pleura, and every phase of pathology of the pleura subject to roentgen study is carefully described in a very comprehensive manner, with the exception of neoplasms.

The third section includes various conditions of the bronchi and tracheobronchial lymph nodes.

The fourth section deals with pathological conditions of the lungs, including congestion, edema, pneumonia, abscess, gangrene, emphysema, fibrosis, atelectasis, tuberculosis, malignant growths and hydatid and dermoid cysts.

The final section refers to penetrating wounds by war projectiles, including a clinical and roentgenological study of the subject. Several methods of localization of foreign bodies are referred to and the indications for and contra-indications against removal are discussed.

H. K. P.

A MANUAL OF PHYSIOLOGY. By G. N. STEWART, M.A., M.D., Professor of Experimental Medicine in Western Reserve University, Clinical Physiologist to Lakeside Hospital, Cleveland. Pp.1245; with 1 colored plate and 492 other illustrations. New York: William Wood & Co.

IN the preface to the eighth edition of this standard text the author notes the decrease of the output of research work due to the withering influence of the war. The plan of the book in general does not show many changes from the preceding edition. However, a number of additions have been made, especially in the portions dealing with the chemical phenomena of respiration, the function of the endocrine glands and metabolism. The modern theory of urine formation as recently formulated by Prof. Cushny is given some consideration. A new feature is the addition of references to original sources in the form of an appendix. This is a most useful bibliography, extending to 64 pages, and showing a careful selection of titles. Recent papers are usually cited in preference to older ones on the same subject. If proper use is made of this excellent list of papers by those in charge of student laboratories great advantages can accrue to the student. One method is to assign to each student a definite paper for short review, and at intervals during the session, to have the men read these before the class. In this way, the student is brought into direct contact with the results of original work, and he in turn distributes something of his information to his classmates. Many will find interesting the author's short discussion in the preface of the relation of laboratory work to text-book information.

W. A.

ON THE NATURE OF THINGS. By HUGH WOODS, M.D., B.A., F.C.S. Pp. 248. New York: William Wood & Co.

FOR the general student of science, with a classical or metaphysical bent, this book will serve as a gently stimulating library companion. The author is evidently a great admirer and close student of Lucretius, and he here reasserts the doctrine of the poet of more than 2000 years ago and amplifies it with some of the results of modern scientific investigation. He finds that what Lucretius stated in his verse is still regarded as fundamentally true, and one can infer that the author, after the manner of the ancients, would enjoy a disputation with any one venturing to differ. W. A.

PHYSIOLOGY AND BIOCHEMISTRY IN MODERN MEDICINE. By J. J. R. MACLEOD, Professor of Physiology in the University of Toronto; Formerly Professor of Physiology in the Western Reserve University, Cleveland; Assisted by Roy G. Pearce and by others. Pp. 233; illustrations, including 11 plates in color. St. Louis: C. V. Mosby Company.

ONE of the aspects of research and teaching which is receiving attention by several groups of active scientific men at the present time is how to distribute the results of recent work, in any line, to those who ought to know about them and to use them in their professional work. Or, viewing the same situation from the standpoint of the individual, the question often arises, "How is one to keep up with the recent literature?" It is agreed that any scheme for making available the knowledge on scientific subjects at a given time must include three distinct types of publication: (1) current bibliographies in all the various lines of scientific work; (2) annual reports on the progress of studies; (3) systematic treatises and handbooks on all major subjects in research and practice. It is earnestly to be hoped that American organization and scholarship will enable this country to become independent along these lines. In the meantime, books of the type of the one under review are very important and fill a useful place in the distribution of knowledge. In this volume the authors review those portions of physiology and biochemistry which they believe to be of special value to the clinical investigator. They aim to present the current knowledge of human physiology, in so far as this can be used, in a general way, to advance the understanding of diseases. The applications of biochemical knowledge are considered in relation to some of the obscure problems of clinical medicine, such as those of diabetes, nephritis, acidosis, goitre and myxedema. Many topics that are ordinarily passed over cursorily in the text-book are treated quite at length. Such is the

case, for example, in the chapters relating to the chemistry of respiration, metabolism of carbohydrates and fats, problems of dietetics and growth, neutrality regulation in the animal body, and to the action of enzymes. Under these headings are brought together the results of recent work, and in each the attempt is made to show the experimental basis upon which many procedures in modern clinical medicine depend. Written with this point of view, the volume will serve as a most useful treatise for the physiologist and well-informed physician.

W. A.

SURGICAL TREATMENT. By JAMES PETER WARBASSE, Surgeon to the Wyckoff Heights Hospital, Brooklyn, N. Y. Volume II. Pp. 827; 761 illustrations. Philadelphia and London: W. B. Saunders Company.

WARBASSE continues in this the excellent work of the first volume. To appreciate the scope of the volume one must keep in mind that it is confined to surgical treatment. To fill a work of this size by therapeutic considerations alone requires a fairly thorough sifting of the literature, and this has been accomplished, to a remarkable degree, without padding or repetition. Three hundred and twenty pages, or about two-fifths of the volume, are devoted to treatment of conditions of the head, a large portion of this section being confined to the specialties, including those of the eye, nose, pharynx, larynx, mouth and ear. One may fairly question the desirability of giving so much space to the treatment of conditions which the average surgeon of today practically never sees. Yet the text is so brief and interesting and the illustrations so numerous and so well adapted to the purpose for which they are employed that the average surgeon would probably prefer to have these specialties included. The general surgeon will probably gain a more serviceable knowledge of such conditions from a resumé made by a general surgeon after careful study of them. On the other hand, there is probably a wide variation in the extent to which different general surgeons will encroach upon the operations and surgical treatment usually reserved for the specialists.

Thirty-eight pages are devoted to the spine and thirty-six to the neck. Fractures of the spine are not considered here, and in the main only orthopedic phases of the spinal affections. Under the thorax we find an excellent resumé of the modern treatment of a few important surgical conditions, like empyema and abscess of the lung, including the tuberculous variety. The heart and esophagus receive special attention. An important feature in connection with abdominal surgery is the devotion of nearly forty pages to the detailed discussion of such interesting phases as preparation for operation, incisions through the abdominal wall with excellent illus-

trations, control of gauze pads and instruments during the operation, prevention of adhesions and postoperative treatment. Twelve pages are given to observations on peritonitis in all its phases, including the tubercular variety. Of the abdominal organs only the gastro-intestinal tract, with the pancreas and spleen, are included. As stated in the beginning, this volume fully maintains the standard set in the first.

T. T. T.

ESSENTIALS OF SURGERY. By ARCHIBALD LEETE McDONALD, Formerly in Charge of the Department of Anatomy, University of North Dakota. Pp. 265; 46 illustrations. Philadelphia and London: J. B. Lippincott Company, 1919.

THE principles of surgery are discussed without direct reference to the nursing of surgical conditions, the purpose of the work being to give a nurse a reasonable conception of the surgical condition from which her patient is suffering. About forty pages are concerned with the various phases of infection. Tumors, wounds, hemorrhage, surgical operations and anesthesia are briefly covered, and then follow elementary resumés of the surgery of various tissues and organs of the body. Thirty-four pages are devoted to a glossary of important words associated with surgery. A knowledge of the contents of this book by a nurse must make for greater efficiency.

T. T. T.

WAR SURGERY OF THE FACE. By JOHN B. ROBERTS, A.M., M.D., F.A.C.S., Professor of Surgery in the University of Pennsylvania Graduate School of Medicine. Pp. 442; 256 illustrations. New York: William Wood & Co., 1919.

THE publication of a treatise on plastic reconstruction after facial injury is timely in meeting the reawakened interest in the subject. This volume is by no means limited to war injuries, but contains a wealth of information on allied subjects applicable in the management of traumatic lesions of the head and face. The literature of recent experience is correlated with the sound principles of reparative surgery by an author of mature judgment, who writes with authority on civil practice, and with modesty while endorsing the opinions of those actively engaged in the treatment of wounded soldiers.

A section on the surgical anatomy of the face presents well selected illustrations from standard text-books. The major portion of the volume is divided about equally between sections on pathology and treatment of war wounds of the face and reconstructive treatment of war injuries of the face. The former includes associated lesions of the neck, the cranium and organs of special sense; surgical

shock, hemorrhage, anesthesia, radiographic diagnosis: the latter includes short chapters on shell-shock, traumatic neuroses and neurectomy of nerves of the face.

The illustrations, like the text, will in large measure apply to industrial injuries. It is to be hoped that a second edition will show some rearrangement of paragraphs for the sake of their value, and spelling less suggestive of haste in publication. G. M. L.

STEREOSCOPIC ATLAS OF PLASTIC SURGERY OF THE FACE, HEAD AND NECK, WITH CASE REPORTS. By JOSEPH C. BECK, M.D., F.A.C.S., and IRA FRANK, M.D., F.A.C.S. Pp. 132; 90 illustrations. St. Louis: C. V. Mosby Company, 1919.

THE authors present here a method of studying plastic surgery of the face, head and neck by means of stereoscopic illustrations and a small text volume which sets forth the principles of plastic surgery of these parts, together with case reports accompanied by many photographic illustrations. An attempt has been made to summarize the most frequent operations as given to the men of the Medical Reserve Corps. The stereoscopic illustrations are actual reproductions from the cadaver. For more detailed information the reader is referred to Loeb's *Operative Surgery* or an appended bibliography, which refers especially to the plastic work done since the war began. We are all familiar with the usual type of diagrammatic illustration used for this kind of surgery, and this newer method will be welcomed by all interested in this special field. The most important operations illustrated are palatoplasty, cheiloplasty, meloplasty and blepharoplasty. T. T. T.

PROGRESS OF MEDICAL SCIENCE

PEDIATRICS

UNDER THE CHARGE OF
THOMPSON S. WESCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Recovery of Normal Weight in the Various Organs of Albino Rats on Refeeding after Underfeeding from Birth for Various Periods.—JACKSON and STEWART (*Am. Jour. Dis. Children*, May, 1919, No. 5, vol. xvii), in a comprehensive research on white rats, have shown some interesting points that may be of great value when applied to the infant, insufficiently nourished and under the proper regime brought to a normal state of nutrition. The data in this series brought out first that albino rats underfed from birth to three, six, or ten weeks of age, showed rapid growth in body weight upon ample refeeding. Body weights of from 25 to 75 gm. were apparently reached more rapidly in those refed after underfeeding to ten weeks of age than in those refed after underfeeding for shorter periods. The body length remained slightly above normal in the group refed to 25 gm. body weight, but appeared nearly normal in the others. The tail length and the weight of the head, limbs and trunk appeared nearly normal in all of the refed groups. As to the body systems the integument appeared subnormal in weight in the group refed to 25 gm., usually normal (or above) in the others. The ligamentous skeleton appeared nearly normal in all of the refed groups, but the cartilaginous skeleton (moist or dry) tended to be subnormal in weight. The musculature was nearly normal in weight, with a slight apparent deficit in the later refeeding periods. The visceral group, as a whole, and the remainder of the tissues showed no constant or significant variations in the findings in the refed group. The individual organs differed greatly in the extent to which they had recovered their normal weight, as compared with that in controls of the same body weight, in the various groups refed to a body weight of 25, 50 or 75 gms. after underfeeding from birth to three, six or ten weeks of age. The weights of the various organs in the refed rats were as follows: The hypophysis and suprarenal glands were apparently nearly normal in weight in all groups: likewise the heart, lungs and kidneys, excepting an apparent overweight of doubtful significance in the groups refed after underfeeding to ten weeks of age. The liver was

rather irregular in weight, but probably within the range of normal variation. The brain, spinal cord and thymus appeared almost constantly subnormal in weight in all of the test groups. The apparent loss in the pineal body was of somewhat uncertain significance. The thyroid gland appeared subnormal on refeeding to 25 and 50 gm. after underfeeding for three weeks; otherwise normal. The ovaries were irregular in weight, apparently subnormal in those refed after underfeeding for ten weeks. The epididymides appeared subnormal on refeeding to body weight of 75 gm. The empty stomach and intestines were usually above normal weight in the refed groups; the canal with contents appeared more nearly normal in weight. The length of the intestines were somewhat above normal on refeeding to 25 gm. body weight and nearly normal later. There was little change in the relative length of the large and of the small intestines. The eyeballs showed a slight overweight of doubtful significance. Two organs showed an apparent tendency to overcompensation growth in the earlier stages of refeeding, with later retardation. The spleen was greatly above normal weight at body weight of 25 gm. or 50 gm.; but was normal or subnormal at body weight of 75 gm. The testes showed a similar reaction, the apparent atrophy in later stages of refeeding being especially marked.

Factors Affecting the Antiscorbutic Value of Foods.—HESS and UNGER (*Am. Jour. Dis. Children*, April, 1919, No. 4, vol. xvii) discuss some advanced ideas in regards to scurvy and its causes and prevention. Many reports show that during the late war there was considerable scurvy among the troops of the various armies; least of all along the western front. The scurvy was mainly of the latent or subacute type, and influenced the character of some of the infectious diseases, and may well have been a factor in the congelations occurring among the soldiers in the trenches. It is evident also that scurvy prevailed among the civilian population to a degree far greater than in peace times. In infants the question of scurvy centers about the milk supply. An infant requires fully one pint of fresh raw milk daily to protect it from the disorder. If the milk is pasteurized, or stale or heated for a second time or rendered more sensitive to deterioration by means of an alkali—and particularly if more than one of these influences are in operation—more than a pint is needed. The fact that there is an inverse relationship between the amount of milk consumed and the tendency to scurvy shows that we are dealing with not an exogenous toxin, but argues in favor of the disorder being primarily a deficiency disease. Milk does not necessarily lose its antiscorbutic value in the course of drying. If it is dried rapidly, even at a temperature of about 240° F., it retains sufficient of the protective factor to have curative value, provided, naturally, that it was fresh at the time of drying. In considering the question of the destruction of this "vitamin" by heat or alkali, the duration of exposure to the detrimental influence is of the greatest importance. Babies fed on pasteurized milk should receive an antiscorbutic from the time that they are a few weeks of age, as there is no reason for allowing the negative balance of "vitamin" to continue for a longer period. A small amount of orange juice will answer the purpose, and is potent for a period after alkalization. Its value does not

reside in its laxative properties, nor in its salt content, as artificial orange juice has practically no therapeutic effect. If orange juice is filtered, boiled and rendered faintly alkaline, it may be given intravenously without causing any slightly untoward reaction. In this way a very prompt cure can be accomplished. From a pathogenic viewpoint, a result obtained by this route is of interest as demonstrating that scurvy can be counteracted by a therapy acting quite apart from the alimentary tract. Diuresis and catharsis do not play an important role in the cure of scurvy, as they may be stimulated to a high degree without alleviating the symptoms. This fact argues against regarding this disorder as essentially toxic in nature. It was found also that giving an antiseptic such as sodium benzoate was without effect. Dehydrated vegetables were without effect in two instances in which an equivalent amount of fresh vegetables brought about a cure. It is not to be inferred from this that dehydration necessarily destroys this "vitamin." In this connection too much attention has been paid to the degree of the heating process, and too little to the more important factors—the age of the vegetables, their freshness previous to dehydration, and their manner of preservation. For about a year strained canned tomatoes have been given in the place of orange juice to a large number of infants. This substitute has been found to be a very effective antiscorbutic, and is well borne by babies even only a few weeks of age. It has the advantage of low cost and availability, and therefore is of particular value for the infants of the poor.

Autoserum Treatment of Chorea.—BROWN, SMITH and PHILLIPS (*British Jour. Children's Dis.*, January-March, 1919, Nos. 181-183, vol. xvi) describe a recent addition to the therapy of chorea, for which they claim more definite and marked results than have followed the former methods used. In practically every instance in their series there had been previous medical treatment given with the usual indifferent and usually fading results. In most cases there was a mild reaction in the form of vomiting and an occasional rise in temperature, and on only one occasion was the reaction of such a nature as to prevent the return of the patient to the clinic owing to parental objection. The withdrawal of an equal amount of fluid as of serum injected did not appear to be necessary. It occurred to the authors that failure to obtain satisfactory results and prompt reaction might be due to the lack of sufficient antibody production in the plasma. This seems quite within the limits of possibility, taking into consideration the individual varying susceptibility to disease. It is most essential that both tuberculosis and syphilis be excluded, and that all drug therapy be suspended for at least five days previous to the injection. Most serious results have been encountered when this latter point has not been observed. Drugs circulating in the blood-plasma have a much more potent effect when injected into the canal, and serious results are thus obtained, particularly after the use of the salicylates, when the very toxic symptoms of salicylic acid poisoning have presented themselves. In practically every instance the treatment was administered in the Out-Patient Department, the patients returning home within an hour or two following the injection. The first step is withdrawing about 50 c.c. of blood from the median basilic vein. In some instances an anesthetic

is necessary, as the patient is often too nervous to keep still sufficiently long to obtain the amount of blood required. Ethyl chloride was the anesthetic used. It is important to have the tourniquet applied just tight enough to impede the arterial flow; the arm is soon emptied of the venous blood, and no more can be obtained until the tourniquet is released. A good plan in this connection is to use a blood-pressure band on the arm, and to have it inflated to about two-thirds of the blood-pressure. The blood is received into three sterile test-tubes, the rubber tubing and the needle having been previously sterilized and held, so that the opening in the test-tube is protected from contamination by a piece of sterile gauze wrapped about the rubber tubing down to its point of entrance into the test-tube, the gauze from there on being held about the test-tube. The tubes are stoppered with sterile plugs, and set aside for a few minutes to allow the blood to clot. Before putting into the centrifuge a sterile platinum loop is run down inside each tube to separate the clot from the test-tube in order to obtain the greatest amount of serum possible. The test-tubes are then put into the centrifuge for thirty to forty minutes. At the end of that time the serum is drawn up into a sterile pipette, emptied into a sterile test-tube, and put in the incubator to keep it at the proper temperature for injection. In the first 4 cases of this series the serum was injected after having been inactivated. Later this was omitted, and absolute trust was placed in the technic to keep the serum sterile. From 50 c.c. of blood 20 to 25 c.c. of serum is obtained. The preparation of the serum takes from one to one and a half hours. The patients were received about nine o'clock in the morning and the serum was ready at eleven. The patient is prepared for lumbar puncture. An anesthetic is always used, and he has no breakfast. The serum is drawn into a 20 c.c. Record syringe, which fits the ordinary lumbar puncture needle. Then the patient is anesthetized with ethyl chloride, the needle inserted, and about 20 to 25 c.c. of spinal fluid withdrawn. The Record syringe is then attached, and the serum slowly injected. This is the crucial step in the operation, as it is essential to give as much serum as possible without causing pressure symptoms. As one slowly injects the serum, when sufficient has been injected, one feels definite obstruction to the entrance of serum. Further injection after this resistance to injection has been encountered, invariably results in marked pressure symptoms, such as vomiting, severe headache, elevation of temperature. An anesthetic is necessary to enable one to detect this sense of resistance. In this series of cases there was used on an average 17 c.c. of serum. The patients were kept in the hospital for one to two hours to watch for pressure or heart symptoms. They were then sent home to bed for one week, when they returned to the hospital. In the meantime they were visited by the public health nurses to see that instructions were carried out. Usually improvement followed in two or three days, and became stationary again by the end of the week, when they returned to the hospital and another treatment was given. Following the injection there may be mild disturbance, such as a slight rise of temperature, slight stiffness of the neck, or increased pulse-rate. These rapidly pass off. Nothing solid is given to eat six to eight hours following the treatment. This method of treatment was productive of infinitely more satisfactory results than any other form of therapy. A cure

of 77 per cent. of the cases was effected within three weeks' time. The technic is so simple that it may be employed in any home or out-patient department under mild anesthesia. With the observance of the proper precautions the reactions are negligible. There were no recurrences in over a period of a year and a half, but more time is necessary in order to give a more definite decision on this point. In view of the fact that chorea is generally recognized as a bacterial disease due to a streptococcus of the viridans group, certain antibodies must be in the circulating blood-plasma, which antibodies do not enter the cerebrospinal fluid on account of the choroid plexus, which does not permit the transmission of these antibodies into the spinal canal. When the serum is injected into the canal a certain chemotactic action takes place, and the walls of the choroid plexus become permeable.

Syphilis and its Relation to Infant Mortality.—JEANS (*Am. Jour. Syphilis*, January, 1919, No. 1, vol. iii). Death in a syphilitic infant may result from the infection alone, from a progressive malnutrition, or because of a lowered resistance and accidental intercurrent disease. Often all three factors are concerned, because an infant dies of pneumonia does not mean that syphilis played no part in the outcome. Most of the deaths occur under ten months of age, and the mortality is appreciably lowered after seven months. The statistics show that from 10 to 20 per cent. of adult males and about 10 per cent. of married females are syphilitic, and a minimum of 10 per cent. of marriages involve syphilitic individuals, 75 per cent. of all of the offspring in a syphilitic family are infected. In a syphilitic family 30 per cent. of the pregnancies terminate in death at or before term, a waste three times greater than is found in non-syphilitic families, 30 per cent. of all the living births in a syphilitic family die in infancy as compared to a normal rate of 15 per cent. in the same class. Probably 25 to 30 per cent. of clinically syphilitic infants die as a result of syphilis, 17 per cent. of all the pregnancies in syphilitic families result in living non-syphilitic children, who survive the period of infancy. Over 5 per cent. of our infant population is syphilitic.

The Maloney Method of Reëducation in the Treatment of Chorea.—GROSSMAN (*New York Med. Jour.*, May, 1919, No. 20, vol. cix) says that during the acute febrile period, little in the way of reëducation is possible. Active exercise in this period may be harmful. He found the rest or relaxation exercises, described by Dr. W. J. M. A. Maloney, of value in quieting the patient during this period. The diaphragmatic breathing is of great aid in inducing relaxation of the muscles. The patient is asked to take a deep breath using his diaphragm, restricting his thoracic movements, and at the height of inspiration to pause, then slowly and evenly to breathe out and again to pause. This breathing soon tires the patient if continued too long, so after ten or twelve of these deep respirations have been taken, the depth of inspiration and the pause are shortened until the patient is breathing without effort as in sleep. To relax the muscles, passive movements, in which the muscles are alternately lengthened and shortened, are employed. The muscles of the forehead, cheek and jaw are thus manipulated until wrinkling of the forehead and blinking of the eyelids disappear and the

muscular spasm is eliminated. Next a shoulder is relaxed, then an arm; each in turn must passively move until all traces of muscular tension vanish, and the part lies motionless and flaccid, and falls limply from any unsupported position. Then the leg on the same side should be taken next. After a part is relaxed, those parts previously treated should be briefly dealt with again, in the order in which they were first relaxed. This linking of parts previously relaxed with parts newly relaxed is helpful in bringing the entire body into a state of relaxation. During the passive movements the operator should continually direct the attention of the patient to the control of the choreic twitchings; gradually this requires less and less effort, and soon complete and perfect relaxation is possible. After the temperature and the pulse-rate have reached normal and remained so for several days, and the child has mastered the rest exercises well enough to allow the limbs to be freely moved passively in all directions without exciting either rigidity or spasm, active movements may be begun. At first simple movements, flexion, extension, adduction, and abduction at the joints should be used. These movements should be guided along the normal planes; rhythm, rate and force should be regulated by counting or by using a metronome. Next the patient resists the movement in order that the ability to maintain tonic contraction may be increased; finally the movement is done against the resistance of the operator. This tends to overcome the loss of power in the muscles due to lack of control. When the patient is able, in the recumbent position, to perform all movements in proper time and rate to the normal extent and with the normal force, reëducation to maintain the normal attitude may be begun. Creeping on the hands and knees is first taught; next balancing and creeping on the knees are attempted; finally maintaining the erect attitude and progression are taught. The changes should be made gradually, and the patient must avoid all fatigue. By alternating the rest exercise with active work, several hours a day can be used for reëducation. Precision of movement can be regained by the use of toys, which at the same time will interest and amuse the patient. Building blocks, fishing games, jig-saw puzzles for the younger and for the older children, dominoes, pegs to be fitted in the holes of a backgammon board, and innumerable other toys used in kindergartens may be employed. The aim of the exercises is to encourage freedom, as well as precision of movement; and any incoördination present is corrected, if continued for a sufficient length of time. It promotes continued concentration with increased mental stability.

A Study of Fat Metabolism of Infants and Young Children.—HOLT, COURTNEY, and FALES (*Am. Jour. Dis. Children*, April, 1919, No. 4, vol. xvii) report the following results of their studies on the stools of normal breast-fed infants: "The fat of the stools of normal breast-fed infants, according to our observations averaged 34.5 per cent. of the dried weight and frequently was as high as 50 per cent. The soap fat in the best stools predominated over the other forms of fat, averaging 57.8 per cent. of the total fat, as determined on the dried stool. The average stool of the normal breast-fed infants showed a soap fat of 43.1 per cent. of the total fat, as determined in the dried stool, which would correspond to over one-third of the total fat of the fresh stool. The

neutral fat in the best stools averaged 15.9 per cent. of the total fat; in the average stool the neutral fat was 20.2 per cent. of the total fat. The amount of neutral fat is not affected by the drying process. No constant relation was shown between the percentage of fat in the mother's milk and the percentage of total fat and its distribution in the stool. With a higher total intake of fat, the fat percentage and the soap fat in the stool were somewhat increased. A range of fat absorption from 90.3, 99.2 per cent. of the intake was found in healthy breast-fed infants."

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

Labor in Old Primiparæ.—KAUWER (*Jour. arch. mens. de obst. et de gynec.*, 1917, vi, 207) has made a personal study of labor in primiparæ above the average age in 5300 labors in the clinic at Utrecht. He finds that as the age of the patient increases so does the duration of labor, and the cause of this phenomena is the diminution in the contraction of the uterus. The number of forceps applications increases in the same proportion. The influence of age begins after the twenty-fourth year and is probably the consequence of functional weakening of all the organs of the body. This includes the ductless glands acting on the uterus causing modifications during pregnancy. His statistics showed that at twenty years of age the average duration of the first labor is fifteen hours. At twenty-four years of age, sixteen hours; thirty to thirty-seven years, thirty-eight hours, with a steady increase from the twenty-fourth year. Requiring extraction by forceps at the age of twenty, 5.4 per cent.; twenty-four years, 7.5 per cent.; thirty to thirty-seven years, 21.3 per cent.; thirty-eight to forty-seven years, 34.3 per cent. Eclampsia increases from 0.86 and 0.88 per cent. at twenty and twenty-four years to 3.33 per cent. between the ages of thirty-eight and forty-seven. Albuminuria increases from 12.3 to 21.5 per cent. at twenty and twenty-four years to 34.2 per cent. at thirty-eight and forty-seven years.

Post Partum Eclampsia.—HAUGH (*Jour. arch. mens. de obst. et de gynec.*, 1917, vi, 224) observed 140 cases of eclampsia among 8600 deliveries in the hospital of Copenhagen. Of these only 19 were post partum, 13.6 per cent. It was evident that age influenced the disease near the time of the onset of labor. The most important factor seemed to be a well marked and free secretion of urine, which marks the beginning of recovery. So far as treatment is concerned that which produces elimination is best of all. Lavage of the stomach and intestine, with the administration of purgatives is indicated. Venesection for eclampsia was practised under Maricean in 1670. In 7 cases in which the writer

removed from 600 to 1000 c.c. of blood, convulsions ceased at once. Other cases so treated did not show such rapid improvement. The majority of observers have found that post partum eclampsia is much less fatal than that which occurs before labor. All of the writer's cases recovered.

Can the Frequency of Some Obstetric Operations be Diminished?—

VOORHEES (*Am. Jour. Obst.*, January, 1918) draws attention to the increase in the performance of many obstetric operations. The high forceps operation and elective version, symphysiotomy and pubiotomy are more or less obsolete. Craniotomy is performed as a last resort on a badly injured or non-viable fetus. On the other hand, induction of labor and Cesarean section are very frequently used as a method of overcoming obstetric difficulties.

Voorhees believes that physicians should study their pregnant patients carefully and that if this precaution were taken that eclampsia would greatly diminish. He cites the statistics of the Sloan Maternity in which eclampsia has diminished in frequency from 1.5 per cent. to 0.8 per cent. This has been accomplished by prenatal observation and care. Manipulation of labor may often change an unfavorable to a favorable presentation. Thus a breech presentation may be converted into a vertex and a brow or face converted into a vertex. In cases where the child shows a tendency to be unusually large much can be done to limit the growth of the infant by restricting the woman's diet. After the sixth month the amount of carbohydrates in the woman's food should be cut down. Two cases are cited in one of which diet was successful and in the other diet accompanied by the induction of labor. The writer believes that long walks during pregnancy tend to make labor easy and comparatively successful. A properly fitting, snugly applied corset worn during pregnancy also tends to bring the head of the child into the brim of the pelvis and to cause moulding sometime before labor begins. When the uterus is allowed to prolapse through the abdominal wall or carrying the abdominal wall with it, abnormal presentations may develop a difficulty in labor. Under some circumstances a decision to perform Cesarean section is easily made and is the only right and logically effective method possible. Pituitrin has an admitted field and patients should be strictly guarded lest the drug be used improperly. While twilight sleep has proved of little or no value attention has been called to anesthesia and the use of nitrous oxide and oxygen and greater care and skill in the employment of ether are distinct gains. Recognizing the desirability of having a first child born a little before full term, labor can often be brought on by the use of quinin and castor oil. The use of the dilating bag is also advisable and the writer states that in 24 cases in the year's practice he has induced thus labor without fetal or maternal mortality. The writer describes a borderline case in which labor was brought on before term by oil and quinin, followed by the insertion of a bag. It was thought that the child was not especially large. The patient became exhausted, although nitrous oxide and oxygen were used to relieve her pain and the choice lay between Cesarean section and high forceps. The latter was selected with the result of the death of the fetus and convulsions ten

hours after labor. No autopsy could be obtained. In another case where the patient had repeatedly lost children by intra-uterine death just before term Cesarean section was performed elective about three weeks before term. An excellent result for mother and child followed. The argument of the writer is that while on the one hand some obstetric operations have been rightly discarded; on the other there is a tendency to resort to Cesarean section in all difficulties of labor when other and less radical procedures might prove successful.

Labor Complicated by Placenta Previa.—ROSSIER (*Rev. méd. de la Suisse romande*, June, 1918) in placenta previa tampons the vagina only when there is not sufficient dilatation of the cervix to admit two fingers. The utmost antiseptic precautions are taken, a speculum having been sterilized before introduction and sterilized iodoform gauze being used from an air-tight container. He believes that with these precautions tamponing is free from objections. If two fingers can be freely passed through the cervix the tampon is contra-indicated and preparations should at once be made for an abdominal operation. The great fault of the Braxton-Hicks method of version is the fact that it condemns the child to almost certain loss and hence if the fetus be viable this method of version should be used only in cases where Cesarean section cannot be done.

The Termination of Pregnancy in Eclampsia.—ROSSIER (*Rev. méd. de la Suisse romande*, June, 1918) strongly urges that in the event of eclampsia occurring the woman should be delivered as promptly as possible by Cesarean section. He describes the case of a patient in whom a convulsion lasted for thirteen minutes, followed by twenty minutes of coma. The blood-pressure was 180, but dropped to 150 after bleeding, and the urine contained 32 per 100 parts albumin. The patient became better, but upon the fourth day blood-pressure had risen to 195 and there were 7 parts per 1000 albumin in the urine, which was very scanty. On the day following the blood-pressure was 210 and the cervix could be entered by one finger only. Cesarean section was performed so soon as possible and mother and child did well. The mother's blood-pressure fell rapidly and there were no further convulsions. The writer has carried out this method of treatment in 19 cases, with a mortality of 21.1 per cent. These results are better than those which he obtained by other methods of treatment.

Incision of the Perineum in Primipara.—POMEROY (*Am. Jour. Obst.*, August, 1918), in a paper read before the American Gynecological Society, raises the question as to whether in primipara it would not be better to make a central incision in the perineum, thus shortening labor and preventing severe laceration. As regards the danger of injury to the sphincter of the bowel, the writer believes that this is avoided by thoroughly stretching and paralyzing this muscle before making the incision. He states that a relaxed sphincter cut in the midline is as accessible and manageable for repair suture as though the perineal body were homogeneous. This procedure is of great value in preventing

risk to the newborn child. Many have perished from birth pressure in a long first labor. This procedure is carried out as follows: Nitrous oxide gas anesthesia is employed, the sphincter of the bowel is dilated with a sterile gloved hand, using tincture of green soap as a lubricant. Labor is allowed to proceed under analgesia until the tissues in the posterior wall of the vagina begin to separate and there is very slight hemorrhage. This foretells inevitable laceration and the patient is completely anesthetized and when the head is not pressing strongly down immediate incision is made with scissors an inch or more up to the posterior column of the vagina and externally nearly to the rectal mucous membrane. All tissues are severed to the rectal wall, except the sphincter of the bowel and by short cuts rather than a long and swift incision. A gloved finger in the rectum is used as a guide. The head is then delivered very gradually with the patient still under anesthesia, either by pressure upon the fundus by an assistant, or with the use of very short forceps, the patient is absolutely asleep and unable to exercise the slightest force. It is sometimes well to insert above the anal margin a stitch to serve as a guard against the extension of the laceration. Where there is no doubt that room enough will not be obtained by median incision to permit the safe exit of the head the sphincter is also incised. Whether this be an entire separation or only a partial one if the sphincter has been relaxed upon stretching there is practically no risk of failure in union. Even should considerable pressure be made upon the rectal tissues no essential and immediate damage will be done. This is illustrated by the fact that prolapse of the uterus is rare in association with lacerations of the perineum to the third degree. Where forceps is used or the child is delivered by breech extraction, the main portion of the levator fascia can be stretched easily through the rectum while the hand is dilating the sphincter. In repairing the tissues chromic catgut No. 1 should be used for all sutures exposed on the skin or mucous membrane or for buried sutures in the sphincter. Plain catgut No. 2 is indicated for all deeply buried interrupted sutures except those in the sphincter. In closing the incision in the median column care should be taken to bring together the edges of the muscular tissue and not merely to close the mucous membrane. So throughout the length of the incision muscular tissues should be brought together. Several supporting stitches of silkworm gut may be used. If the operator desires a continuous buried suture and a subcuticular stitch may be employed. The writer believes that the primiparous woman should always be treated in the hospital and by an expert. While in subsequent labors she may, if desired, remain at home under the care of a conscientious general practitioner. The question arises will a patient so treated have lacerations in subsequent labors? With a view to preventing subsequent laceration the writer has in thirty cases adjusted his operation in such a manner as to secure good union of all the important muscles primarily, thus leaving space for the delivery of children without tearing into the muscular tissue.

The Chemical Constitution of the Placenta.—Some of the most serious complications affecting labor occurred during abnormal conditions in the placenta, and hence the composition of this important organ becomes a matter of very considerable importance. Chemical

analysis of tissue has not always given satisfactory results if in some cases the tissues contain fluid whose composition greatly alters the value of the chemical examination. DRUMMOND (*Biochem. Jour.*, 1916, No. 10). After examining various organs in the body to determine the nitrogen contents and also the placenta found a surprising similarity in the distribution of nitrogen in the tissues of the breast, liver, pancreas, spleen, kidney, and in plain and striped muscle, and this fact gives no basis for speculation regarding the various functions of these tissues. In HARDING and FORT's analysis (*Jour. Biolog. Chem.*, 1918, No. 35) of human placenta they found a large quantity of diamino-acid, argynin and protein, which is not found except in the placenta in so great a quantity. While other human organs contain this the placenta has at least twice the usual amount. By some chemists this substance is supposed to have a part in the formation of creatin and creatinin. It also has to do with the purin compounds, with the material which forms new nuclei. While no definite conclusion can be reached from these investigations, they point to the fact that the placenta from the chemical standpoint cannot be considered as an entirely passive organ and that it has a function which is distinctly different from that of other organs in the human body.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Technic for Releasing Pelvic Adhesions.—There is perhaps nothing more tedious in gynecologic surgery than the proper release of adhesions between the pelvic organs, especially the sigmoid and bladder with the uterus or tubes, as is so commonly seen in pelvic inflammatory disease of gonococcal origin. The separation of the organs is quite easily accomplished in acute cases, but we seldom operate upon the acute cases, so that by the time the surgeon encounters these adhesions they are firm and dangerous to deal with. Each surgeon must solve these problems for himself as the occasions arise but it is always helpful to know what other surgeons are in the habit of doing in similar cases, therefore the methods employed by GRAD (*Am. Jour. Obst.*, 1919, lxxix, 344) in these cases will be of interest. In cases where two hollow organs are adherent, the cleavage method must be followed as one is working between two walls of important viscera. The organs torn, either the bowel or the bladder, must be repaired by suturing the rent since observation has shown that both the sigmoid and the urinary bladder tolerate injury very well and by repairing these rents the suture line will hold in a very large number of cases. Under all other conditions, however, whenever one is dealing with diseased tubes or ovaries

adherent to sigmoid, rectum or loops of small intestine, it is to be borne in mind that separating these adherent bowel structures not along their line of cleavage, but cutting them away at the expense of the parts to which they are adherent, is always preferable according to the experience of Grad. By adopting this technic, the surgeon will have less bowel injuries to deal with, which is a very important point of consideration. Not only in pelvic surgery, but in the repair of postoperative hernias the same principle holds good and there need not be any apprehension about leaving pieces of tissue on the bowel wall as they do no harm. In cases of tubo-ovarian abscesses when the sigmoid or rectum is involved, cases with thick massive infiltration of the mesosigmoid, and where the abscess cavity is draining into the bowel, the same technic can be adopted. By utilizing the adherent tissue on the wall of the sigmoid or rectum as the case may be, the rent in the bowel can be closed more readily. It is true that in a very large number of cases, where the sigmoid has been adherent to diseased adnexa, and the outer coat has been torn during liberation, no suturing is required and no harm will result. The cases get along very well as long as the mucous coat of the bowel is not injured and no bad results will follow, nevertheless it is far better not to injure the outer coat. When the lumen of the bowel has been entered, the complication is a serious one and every attempt should be made to repair the mucous surface as accurately as possible. In repairing the mucous coat of the sigmoid or upper rectum, the inaccessibility of these parts calls for thorough exposure and skilfulness in the placing of sutures; however, with proper repair of the mucous and submucous coats, the healing power of these parts is phenomenal. Having repaired these injuries, the suture line should be allowed to fall against some surface to which it may become adherent, either the posterior surface of the uterus, the cul-de-sac itself or the bowel wall. No drainage material should be placed against the suture line, and certainly no gauze drain should be placed on it. If drainage is called for, it should be placed above the line or to the side of it and it should be remembered that rubber dam is preferable to gauze in these cases.

Postoperative Cystitis.—The frequent occurrence of cystitis after pelvic operations, especially after extensive plastic operations involving the anterior vaginal wall, makes the subject of great importance. From the observation of a considerable number of cases, WATKINS (*Surg. Clinics of Chicago*, February, 1919, p. 213) is firmly convinced that the so-called postoperative catheter cystitis does not usually result from infection from the catheter, but from the presence of an increased amount of residual urine. As an illustration of this contention, he mentions the case of a woman aged forty-five years, who consulted him for uterine prolapse, a large cystocele and lacerated perineum. The uterus was about twice normal size. She had the usual symptoms of prolapse and also had some vesical irritability. Examination of the urine showed cystitis and the use of the catheter immediately after urination showed on an average of $1\frac{1}{2}$ to 2 ounces of residual urine. The lesions were corrected by a modified transposition operation including a high amputation of the uterus and suture of the resulting stump to the fascia underneath the trigone of the bladder. This operation resulted in considerable traumatism to the bladder, which was

already infected and which had defective muscles as the result of having been overstretched and displaced. Following operation she had a partial bladder paralysis which is common and should be expected in such a case and although she was able to pass some urine, it was nearly two weeks before the residual urine became normal in amount. For several years Watkins has given careful attention to the question of increased residual urine, with the result that postoperative symptoms and findings are almost invariably proportionate to the amount of residual urine which the patient carries. The fact that bacteria are often eliminated through the kidney means that bacteria very frequently travel through the bladder cavity, and in the case of the presence of a considerable amount of residual urine, infection is very liable to result. Therefore it has become his custom to test for residual urine as soon as symptoms referable to the bladder develop, and to catheterize at least once daily until the amount of residual urine becomes normal, which is $\frac{1}{2}$ to 1 dram. Instillations of silver are used after catheterization, commencing with a weak solution of $\frac{1}{8}$ of 1 per cent. and gradually increasing the strength should progress be unfavorable. Benzoic acid in doses of 5 grains four or five times daily is given in case the urine is neutral and as soon as the urine becomes acid, urotropin is ordered, commencing with 5 grains three times a day and increasing the amount 5 grains each day until formalin appears in the urine. Then the amount is again diminished until a weak reaction of formalin is obtainable. If the urotropin causes an acute irritation, it is stopped at once and large doses of sodium citrate are given until relief is obtained. The result of this treatment has been that the patients when finally discharged are cured of the cystitis, although in occasional cases it is necessary to continue some bladder treatment after the patient has left the hospital.

Tuberculosis of the Uterus.—Tuberculosis of the uterine mucosa occurs much more commonly than one would suspect from a perusal of current medical literature, according to SCOTT (*California State Jour. Med.*, 1919, xvii, 52). It occurs at all age periods, but is most common in the decade between the ages of twenty and twenty-nine years. The symptoms are disturbances of menstruation, especially metrorrhagia and dysmenorrhea, feeling of weight in the pelvis, progressive constipation, painful defecation and pain radiating from the hypogastrium to the lumbar region, to the upper thorax and along the perineum. The differential diagnosis must be made between carcinoma, chronic endometritis and syphilis of the uterus. The primary form of the disease is comparatively rare, most cases being secondary to disease elsewhere in the body, but it occurs in four main types, namely, ulcerative, miliary, interstitial and peritoneal and of these types, the ulcerative is the most frequently found. The prognosis is extremely unfavorable in all except the rare primary cases. The treatment in the secondary cases must be symptomatic and supportive, but in the primary cases, curettage of the uterus will result in a cure, if the disease has not invaded the Fallopian tubes. If the tubes are involved, hysterectomy must be the operation of choice. Operative procedures on the uterus, when the seat of secondary tuberculosis, are harmful and are positively contra-indicated.

Non-surgical Removal of Ureteral Stones.—There has been much written of late years concerning the removal of ureteral stones by non-operative methods and many different technics have been advocated. In a series of 23 cases which were treated by MERRITT (*Southern Med. Jour.*, 1919, xii, 143) the stone was passed in 21 cases after the use of the following procedure. The cystoscope is introduced and the ureter below the stone is dilated with ureteral dilators. After the introduction of 2 to 4 c.c. of a 2 per cent. solution of papaverin or novocain through a ureteral catheter, the catheter is withdrawn so that the ureteral walls may be infiltrated thoroughly. If a small ureteral orifice obstructs, then use ureteral scissors to cut the meatus to the desired size. After this, pass a stiff catheter to or beyond the stone and inject from 2 to 4 c.c. of sterile olive oil. This is followed by the injection of a few drops of a 10 per cent. argyrol solution for its antiseptic value, and it also possibly reduces the soreness from manipulation. The patient, if not in pain, may sit up, but if in pain, large doses of morphin, hot applications and an abundant intake of fluids are indicated. This procedure is employed at intervals of three days if the condition of the patient will permit, the average number of treatments required being three.

Effect of X-rays on Carcinoma in Vitro.—Some experimental work with mouse tumors has been performed by KIMURA (*Jour. Cancer Research*, 1919, iv, 95) to determine the effects of roentgen-ray irradiation on living carcinoma and sarcoma cells in tissue cultures *in vitro*. In the course of the research, it was found that mouse carcinoma and sarcoma grow as well in guinea-pig plasma to which has been added mouse serum diluted with Ringer's solution as in mouse plasma itself, and the outspreading growth of cells in culture, both sarcoma and carcinoma, was not stopped by roentgen-ray action varying from E 4 to E 12. The mitotic figures of cells were limited to a minimum after an exposure of E 8; after exposure to E 12, however, they disappeared entirely and the treated tissue produced no tumor when inoculated into mice. The growing power of sarcoma after E 4 exposure was stimulated to some extent, while carcinoma was not appreciably influenced. After an exposure of tissues to E 12, both sarcoma and carcinoma, the growing power of these tissues was stopped when inoculated into mice, and eliminated the process of mitotic division of cells. The process of oxidation of tissues, both sarcoma and carcinoma, was stimulated by the roentgen-ray action of E 4 and retarded by exposure to E 12 of the ray. The terms E 4, E 8, E 12 indicate that the Hampson's pastille used showed No. 8 or No. 12 tint, that is, equivalent to a dose $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$ of Sabouraud's B tint.

Primary Chorionepithelioma of the Ovary.—Primary chorionepithelioma of the ovary is rare, indeed some authorities consider the ovary to be by far the most unusual site for the extra-uterine development of this form of malignant tumor, so that a case of this kind, which has been reported by KYNOCH (*Edinburgh Med. Jour.*, 1919, xxii, 226) may be of passing interest. The history of the case is that of a nullipara, aged twenty-four years, who complained chiefly of severe pain in the left iliac region, with irregular vaginal hemorrhagic discharge of six weeks' duration. The menstrual history was negative until fourteen

weeks before the patient was admitted to the hospital, when there was eight weeks amenorrhea, followed by the hemorrhagic discharge just mentioned. On examination, the uterus was found slightly enlarged, and in the left fornix there was felt a round tender swelling about the size of a hen's egg, corresponding in position to the left ovary. Laparotomy was performed and the left ovary was found enlarged, nodular on the surface and of a dark purple appearance. It was of such soft consistence that it ruptured and bled freely during the manipulation necessary for its removal, bringing to mind the possibility of an ovarian pregnancy. The convalescence was uneventful, the patient leaving the hospital three weeks after operation, but one month later she was readmitted complaining of a swelling at the seat of the abdominal incision, which was about the size of a billiard ball, firm and tender and which was regarded as a hematoma. It increased rapidly in size, however, and an incision was made into it and it was found to consist of a liver-like substance. Examination per rectum now revealed a soft doughy tumor bulging into the lumen of the bowel. The patient became progressively weaker and died three weeks later. At autopsy, the pelvis was found filled with recurrent chorionepithelioma and metastases were found in the lungs and liver.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

OSKAR KLOTZ, M.D., C.M.,

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

Results of Prophylactic Vaccination against Pneumonia.—CECIL and AUSTIN (*Jour. Exper. Med.*, 1918, xxviii, 19) reported successful results with prophylactic vaccination against pneumococci of types I, II and III. They vaccinated 12,519 men at Camp Upton, using a saline suspension of dead pneumococci of these three types. The vaccination against type IV was thought impractical. But one case of pneumonia of the types contained in the vaccine occurred during about ten weeks' observation. This case, type I, developed twenty-four hours after the first inoculation, before immunity could have been produced. Nine cases due to type IV pneumococci and seven due to streptococci occurred during the same period. The type IV cases ran a very mild course. 19,481 unvaccinated troops were used for controls. Among these there occurred during the ten weeks' observation 26 cases of pneumonia, due to pneumococci of types I, II and III; 34 cases due to type IV and 106 due to streptococci. They suggested that cross-protection may explain the small number of type IV cases among the vaccinated troops. No explanation is offered to show why the vaccinated troops were spared in the streptococcus-pneumonia epidemic which must have occurred. These results and those previously reported by Lister working in South Africa are very convincing that protection

can be afforded against the specific types of pneumococci used in the vaccine. No cases of the types against which Lister vaccinated occurred over a period of nine months. Experiments made before the inoculation demonstrated the production of agglutinins and the protection the serum of vaccinated individuals conferred on mice. The total dosage to each man was six to nine billions each of dead pneumococci, types I and II, and four and a half to six billions, type III, this given in three or four doses at weekly intervals. The first inoculation contained one billion of each type. The constitutional reactions were slight, only twenty-five men of the entire number vaccinated being sufficiently ill to remain in quarters or the hospital. Those upset by the first or second inoculation usually received no further injections. A small percentage developed tender, painful infiltrations at the site of injection which progressed favorably without surgical treatment. Since the work at Camp Upton, CECIL and VAUGHAN (*Jour. Exper. Med.*, 1919, xxix, 457) vaccinated 13,460 men at Camp Wheeler against pneumococcus infection, using a lipovaccine. By this method one inoculation was sufficient. The dose consisted of 1 c.c. of an oily suspension containing ten billion each of pneumococci of types I, II and III. The local reactions were less than those produced by the saline vaccine. During three months' period of observation the incidence rate of pneumonia of all types among the vaccinated troops was less than one-half that among the unvaccinated. However, 32 cases of pneumonia of the types contained in the vaccine occurred, but of these 24 cases developed within one week of vaccination. These were considered to have occurred before immunity was established. The remaining eight cases were secondary to influenza.

Studies on Tuberculous Infection.—By the use of a strain of tubercle bacilli of the human type of relatively low virulence, KRAUSE (*Am. Review of Tuberculosis*, 1919, iii, 1) has been able to report some interesting facts in man and animals. He used the strain known as Ri, which Dr. Trudeau isolated in 1891. At the time of isolation it exhibited standard virulence for guinea-pigs, but gradually underwent a diminution in degree of infectivity, reaching a point from which it has never varied one way or another in the past twenty years. By inoculating guinea-pigs with Ri it was possible to produce a series of conditions which are in many respects comparable to those obtaining in most human beings suffering tubercular infection. The infection with Ri is slow in developing and does not bring about an advanced tubercularization of the entire body, nor did it ever bring about the death of the animal. The animals were allowed to live for two years and more, and were invariably in perfect physical condition during that time. No gross visceral lesions were found and but slightly altered regional lymphatic nodes. These latter when sectioned always revealed tubercles, usually of a sclerotic type, with central necrosis and caseation. The tracheobronchial nodes had enlarged more than the regional nodes of the same animals and the lesions were of a more advanced type, suggesting infection by way of the respiratory tract instead of subcutaneously. Not the slightest change was to be found in the lungs. The author believes that a similar localization occurs in human beings, that is, the tracheobronchial nodes showing evidence of infection and

the lungs remaining clear. Cornet's work substantiates that of the author's when he found that inhalation of attenuated bacilli in dust set up manifest tubercle in the tracheobronchial nodes, although none were detectable in the lungs. There are many interesting problems involved in such a study, and the author gives his general result in the hope that it may throw some light on the various disputed and important phases of tubercular infection. The resistance of various tissues to the invasion of the tubercle bacillus must be studied and fully appreciated. Also, the peculiar anatomy of the lungs in experimental animals and the human must be carefully considered when drawing conclusions from experiments. This latter point has not received sufficient notice and may aid in solving the great problem of what we may call the "natural" mode of pulmonary infection in human beings, which at present is still in a purely speculative stage.

An Experimental Study of Vaccination against Bacilli Dysenteriae.

—Following upon the development of typhoid and paratyphoid vaccines suspended in vegetable oils by Le Moignic and Pinoy and by Tribondeau OLITSKY (*Jour. Exper. Med.*, 1918, xxviii, 69) applied this method of suspension to dysentery vaccine (*B. dysenteriae*, Shiga and Flexner), with a view to lessening the intensity of the local and systemic reactions produced by saline vaccines of the same organisms. The exact nature of the oils not as yet having been revealed by the French investigators, he experimented first with rabbits, using various oily vehicles for his vaccine. Olive oil saturated with lanolin proved unsatisfactory. Filtering the "lipovaccin" of Le Moignic and Pinoy through a Berkefeld filter and using the filtrate as a vehicle eliminated the toxic reactions. Almond oil used alone as a vehicle also proved satisfactory in rabbits, giving no systemic reaction and a small local reaction. The degree of protection received was as high as that with saline vaccines, this protection remaining practically undiminished for a month; rabbits at this time were protected against ten lethal doses of a Shiga culture and four lethal doses of a Flexner culture injected intravenously. In his experiments with eight men he found that a single injection of a neutralized almond-oil vaccine, 0.5 c.c., containing $2\frac{1}{2}$ billion bacilli, equal parts of Flexner and Shiga, resulted in slight or no systemic reaction and only a moderate local reaction. Agglutination appeared about the seventh day and lasted for at least a month. The slower rate of absorption seems to be responsible for the lessened reaction, the writer showing that while a saline vaccine disappears from the site of injection in twenty-four hours an oily vaccine does not disappear until after the third day.

Rocky Mountain Spotted Fever in the Domestic Rabbit.—The first studies of "tick fever" carried on by Wilson and Chowning indicated that the tick was the medium of transmission, and described a piroplasma in the blood. King and Ricketts confirmed the finding that the disease is transmitted by the tick; but they as well as Stiles (1905) failed to find the organism in the blood. While Stiles had doubted the susceptibility of the domestic rabbit to Rocky Mountain spotted fever, Rucker (1912) reported that rabbits suffered from only a very mild form of the disease. Ricketts and Comez, in a brief publication, asserted that the rabbit was not susceptible to the ordinary virus but

could be infected only after the virulence had been raised by animal passage. Parker, during recent work in Montana, has offered the suggestion that the rabbit may at least be an occasional carrier. Because of this and of the previous differences of opinion, Foot (*Jour. Med. Res.*, 1919, xxxix, 495) repeated Comez's experiments, with some additional work, in an attempt to discover whether the rabbit may not contract this disease. In the first place it was definitely established that infected ticks may transmit the disease to rabbits. The onset occurred seven days after ticks had been applied to a shaved area over the abdomen; the animal showed swelling and tenderness of testes and scrotum, with congestion of the skin over the scrotum; microscopically, typical vascular lesions were found; and the minute diplococcus described by Wolbach was demonstrated in the intima of vessels of the testis and skin. Guinea-pigs inoculated with heart's blood of these rabbits developed a mild and atypical form of the disease. The next step was a study of the susceptibility to injected virus, carried out by intraperitoneal injections of heart's blood from an actively infected donor. This was further studied by transfer from rabbit to rabbit until a rather curious finding was developed, namely, a fairly natural immunity of the rabbit. Certain it is that rabbits sustain the infection much better than guinea-pigs. Only two out of a series of twenty-two rabbits died spontaneously, while guinea-pigs practically succumb at the seventh to ninth day of the disease. The statement of Ricketts and Comez that the offspring of immune parents in the case of guinea-pigs are immune to the disease and that even if only one parent were immune there is still a certain amount of immunity conferred on the offspring, led to a series of breeding experiments, with the conclusion that there is no certain transmission of immunity in the case of the domestic rabbit. Under the heading of gross pathology are included the findings of acute hemorrhagic orchitis and epididymitis, frequently going on to necrosis; acute splenitis; acute inguinal lymphadenitis; the liver and lungs showed only congestion; the skin showed petechial hemorrhages; the ears were swollen, tender and injected, and, later, owing to thrombosis, gangrene and sloughing frequently destroyed a large part of these structures. Microscopically, the lesions were found in the smaller veins and arteries and the capillaries of certain organs. Here the endothelial lining showed intense proliferation, with frequent mitotic figures. This proliferation was so marked that necrosis of the heaped-up cells occurred with resultant thrombosis of the vessels. The diplococcus of Wolbach was found in these intimal lesions, likewise in the media, and in the large perivascular endothelial collections which were also a feature of the reaction. The proliferative reaction was soon complicated by migrating polymorphonuclear leukocytes, fibrin and other inflammatory products. It is readily seen, therefore, that such reactions, by occluding vascular channels, are the basic factor in producing hemorrhage, infarction and gangrene, the chief characteristics of the disease.

The Fate of Typhoid Bacilli Injected Intravenously into Normal and Typhoid Immune Rabbits.—Following the work of Hopkins and Parker on the fate of hemolytic streptococci injected into susceptible

and immunized animals, PARKER and FRANKE (*Jour. Med. Res.*, 1919, xxxix, 301) took up the study of the same phase of immunity. They report a failure to confirm the finding of the previous workers that the organisms are largely taken up by the lung. In the latter study, however, the *B. typhosus* was employed, owing to the greater ease with which rabbits may be immunized to this organism. The technic included injection of a twenty-four hour agar slant culture emulsified in sterile saline solution. Normal animals were killed within ten minutes after injection and the various organs were tested out immediately for their bacterial content. Portions of the same organs were also incubated, during three or four hours, in order to study the bactericidal action of these tissues *in vitro*. The bacterial count on the various tissues was accomplished by a plating method being estimated on the number in 0.1 gm. of tissue ground up in 1 c.c. of sterile saline solution and cultured in poured agar plates. The results of these experiments on normal rabbits indicate that the liver contains by far the greatest number of organisms per weight unit. The spleen averages half as many, and the lung and bone-marrow about one one-hundredth of the count in liver. Cultures from the incubated tissue showed evidence of bactericidal action only in the lung. Here, however, the interesting fact was discovered that the bacterial count was reduced to one-twentieth of that in lung cultured immediately after removal. The same experiment *in vivo* accomplished by allowing the injected rabbit to live for three or four hours produced the opposite result, in that of all the body tissues the bone-marrow alone showed bacteria. To allow this condition to either readjust itself or reach its maximum another animal was injected with the usual dose and allowed to become moribund before being killed. This animal, then, after fifty-three hours, gave a bacterial count of millions of *B. typhosus* in the bone-marrow while the other organs showed numbers running in the hundreds. A similar series of experiments was then undertaken with immunized animals; but the results, as previously stated, were merely to indicate that a slightly greater localization of bacteria occurs in the lungs in the immunized animals. There is no difference in the bactericidal power of the tissues of normal and immunized rabbits. The bone-marrow, in its new role as a harbor for active bacteria, from which the blood stream may be invaded at recurrent periods, is an interesting fact brought out by this work.

A Bacillus of the Colon Group Isolated from Cystitis Urine.—The *B. coli* group as probably the most frequent cause of cystitis is again brought to the fore by an elaborately worked-out study of a recently isolated atypical strain of this organism. NIVA (*Jour. Med. Res.*, 1919, xxxix, 469) recovered the organism in question in pure culture from a case of chronic cystitis in an elderly individual. The morphological and cultural characteristics were worked out by him in great detail. Fermentation reactions were studied on a series of nine sugars. The usual biochemical tests were performed, with the exception of that for the reduction of nitrates. Motility was not demonstrable, even in very young broth cultures. In general it may be said that the organism corresponded exactly to the typical *B. coli communis*, save in its reaction on some of the more unusual differential sugars and in the absolute

absence of motility. The sum total of the study of this culture revealed a strain slightly different from any yet isolated, though it finds its place as one of the theoretical subgroups in several of the standard classifications. Pathogenicity for the mouse and guinea-pig was studied, with positive findings in these animals. Agglutination tests were made, using the serum of the patient, the serum of one of the inoculated guinea-pigs which had developed a subcutaneous abscess due to the organism in question and the serum of a normal individual. The serum of the patient and of the experimental animal had strong agglutinating power. The conclusion that the organism was the cause of the cystitis seems well substantiated. A very full list of bibliographical references is appended.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

MILTON J. ROSENAU, M.D.,

PROFESSOR OF PREVENTIVE MEDICINE AND HYGIENE, HARVARD MEDICAL SCHOOL,
BOSTON, MASSACHUSETTS,

AND

GEORGE W. McCOY, M.D.,

DIRECTOR OF HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE,
WASHINGTON, D. C.

Increase in Tuberculosis Emphasizes the Need of Food Education.—The statement cabled from London that Germany is suffering an enormous increase in tuberculosis, mainly as the result of the restricted food supply, calls forth a warning from the Department of Health of New York City (*Weekly Bull.*, Dpt. of Health, City of New York, December 29, 1917) that despite a much greater amount of food in this country a similar disastrous increase in tuberculosis and other diseases may occur here if the public does not take a greater interest in the science of nutrition. Statistics compiled by Dr. W. H. Guilfooy, the Health Department's Registrar of Records, show that the steady downward course of the deaths from tuberculosis has not only been arrested but that the number this year shows an actual increase over last year's figures. In view of the experience of the other warring nations, this is certainly disquieting. Inasmuch as tuberculosis is so intimately associated with undernourishment, special interest attaches to the report concerning the physical examination of school children. According to this, the number of undernourished school children in New York City is much greater than was heretofore suspected, for one-eighth of all the school children were found to be undernourished. On the basis of a million school children this represents the enormous number of 125,000 undernourished children. One-quarter of this number were so badly undernourished as to require medical care. The Department of Health has been much concerned about the great lack of even elementary knowledge among a large proportion of the people concerning the main facts of food and nutrition. For some years an

effort has been made to teach the people by means of posters, leaflets, food exhibits and demonstrations, but progress is slow. Classes of practical instruction in dietetics have been begun at some of the Baby Health Stations. This work is carried on by the nurses of the health stations, for they know the needs of the mothers in their district.

The Regulation of the Intestinal Flora through Diet.—TORREY (*Jour. Med. Research*, January, 1919, p. 415) states that it is now well known that diet exercises a profound influence on the determination of the types of bacteria developing in the intestinal tract. In fact, under conditions of normal physiological functioning within the digestive tube it is the fundamental factor. The work of HERTER and KENDALL (*Jour. Biol. Chem.*, 1910, vii, 203) was the first to establish clearly this fact. Under normal physiological conditions the fundamental factor controlling the types of bacteria vegetating in the intestinal tract is the chemical character of the food ingested. Secondary controlling factors of almost equal weight are the rate and degree of the digestion and absorption of the food and the character of the end-products of the digestive process. It has been demonstrated experimentally in Torrey's investigation with dogs that, on the one hand, not all carbohydrates have an equal tendency to establish a purely fermentative intestinal flora, and, on the other hand, not all protein foods encourage putrefactive conditions in a like degree.

The Effect of Carbon Dioxide in the Cultivation of the Meningococcus.—GATES (*Jour. Exper. Med.*, 1919, 4, xxix, 321) states that the meningococcus is not a "micro-aërophile." It grows equally well in atmospheres containing from 15 to 40 per cent. oxygen. If small amounts of carbon dioxide affect the growth of the meningococcus on an artificial medium it is by changing the reaction of the medium, not by slightly reducing the oxygen tension of the surrounding air. The fallibility of titrating the total acidity of a medium is again clearly demonstrated. A reaction favorable to the meningococcus cannot be determined from the total titratable acidity but depends solely upon the hydrogen ion concentration of the medium. The optimum for the meningococcus is approximately at pH 7.4. The value of a moist chamber in the cultivation of the meningococcus is shown by unusually luxuriant growth when other conditions are also favorable.

Pneumonia Following Influenza.—MCCALLUM (*Jour. Am. Med. Assn.*, 1919, lxxii, 720) states that the epidemic disease influenza resembles in many respects measles and other acute exanthematic diseases. Nothing is definitely known as to its causative agent. It produces great lowering of resistance to bacterial invasion and is therefore often followed by pneumonia caused by the different types of pneumococcus, *Staphylococcus aureus*, *Streptococcus hemolyticus* or the influenza bacillus of Pfeiffer. In some regions the influenza bacillus is a particularly common secondary invader. In other regions it is insignificant, its place being taken by one of the pneumococci. This may depend on an epidemic or endemic distribution of these organisms as inhabitants of the nasopharynx. The form of pneu-

monia produced after influenza is greatly modified by the lowering of resistance, which allows huge numbers of bacteria to grow. Nevertheless, the types caused by the pneumococcus, streptococcus and influenza bacillus are to be sharply distinguished. Probably the type caused by the staphylococcus will be shown to have distinctive peculiarities when adequate material has been studied.

The Effect of Pressure on Certain Microörganisms Encountered in Preserving Fruits and Vegetables.—HITE (*Bull. 146, West Virginia Agricul. Exper. Sta.*, October, 1918) finds that a pressure of 100,000 pounds per square inch at room temperature destroys most non-spore-bearing bacteria. Under these conditions milk containing from 30 to 40 millions per cubic centimeter may be reduced to a few hundred by the application of 100,000 pounds for ten minutes. The pressure does not affect the enzymes. Forty-five thousand pounds' pressure is sufficient to kill *B. typhosus* in beef broth in ten minutes. *B. diphtheriæ* in beef broth are killed at 40,000 pounds' pressure in ten minutes.

Relation of Meteorological Conditions to the Prevalence of Pneumonia.—GREENBERG (*Jour. Am. Med. Assn.*, 1919, lxxii, 252) states that in studying the death-rate of lobar pneumonia in its relation to meteorological conditions, it has been found that: (1) Temperature *per se* is the most important controlling factor; (2) a low relative humidity is conducive to a high-death rate, and a high relative humidity to a low death-rate; (3) increases in the death-rate correspond to increasing temperature variations.

Origin of the So-called Auto-intoxication Symptoms.—ALVAREZ (*Jour. Am. Med. Assn.*, 1919, lxxii, 8) states that "auto-intoxication" is commonly diagnosed when a physical examination would show other more definite causes for the symptoms. Those who believe that intestinal stasis can account for a long list of disease conditions have little proof to offer for their views. Many of the assumptions on which they rest their case have been proved to be wrong. The usual symptoms of the constipated disappear so promptly after a bowel movement that they cannot be due to absorbed toxins. They must be produced mechanically by distention and irritation of the colon. They occur in nervous, sensitive people. It has been shown that various activities of the digestive tract can profoundly affect the sensorium and the vasomotor nerves. The old ideas of insidious poisoning lead to the formation of hypochondriacs: the new explanation helps to cure many of them.

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DR. GEORGE MORRIS PIERSON, 1913 Spruce St., Philadelphia, Pa., U. S. A.

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ORIGINAL ARTICLES

ONE ASPECT OF SYPHILIS AS A COMMUNITY PROBLEM.

BY H. S. NEWCOMER, M.D., RUSSELL RICHARDSON, M.D.,

AND

CHARLOTTE ASHBROOK,

(From the Pennsylvania Hospital, Philadelphia.)

WITH AN INTRODUCTION BY

PAUL A. LEWIS, M.D.,

OF THE HENRY PHIPPS INSTITUTE OF THE UNIVERSITY OF PENNSYLVANIA.

INTRODUCTION (Lewis). Syphilis was recognized by the older of the present-day physicians as being a most frequent and important deleterious factor in the health of the community. Witness Osler's sentence with reference to the general diagnosis of the disease: "It is to be remembered that syphilis is common in the community, and there are probably more families with a luetic than with a tubercular taint." Unfortunately, the more precise studies of recent years have only served to emphasize the truth of this belief.

Vedder gives a careful review of the results of many "Wassermann surveys." He reaches the conclusion that, making due allowance for the failure of the reaction to detect many cases of latent syphilis, probably 15 per cent. of the population are tainted with disease. No attempt to arrive at a universal or blanket figure can be altogether acceptable, but this estimate is probably as fair as can be. Certainly, an estimate of 10 per cent. would be conservative.

More tangible are the results of the study of particular groups among the population. Dr. Davies, at my suggestion, made

Wassermann tests on about 250 persons as they came into the receiving ward of the Pennsylvania Hospital. The persons were not selected; that is, the blood was taken without reference to any other symptom of syphilis. The result showed that about 10 per cent. gave positive reactions. In other words, more than 10 per cent. of all persons presenting themselves to a general hospital for treatment are either there because of syphilis or their illness is complicated by a coexistent syphilis. Dr. Davies also examined 218 cases presenting themselves in the dispensary of the Phipps Institute without selection; 6.5 per cent. gave positive reactions. Further, Dr. S. T. Orton has supplied me with figures from the Pennsylvania Hospital for the Insane showing that approximately 20 per cent. of the male patients and 6.5 per cent. of the female patients give positive Wassermann tests. The Wassermann test used in this way gives a figure certainly less than the actual, and it may be conservatively stated that 15 per cent. of the work of a representative hospital for the insane has to do either directly or indirectly with syphilis.

When it is stated that the conditions widely known as locomotor ataxia and general paralysis are manifestations of syphilis, such figures as these, drawn from the patients of our general hospitals and our insane hospitals must show clearly to any one, even though untrained in medical science, the mass of pure and now unadorned misery attributable to this disease.¹

Again, Osler² writes: "The State accepts the responsibility of guarding citizens against smallpox or cholera, but in dealing with syphilis the problem has been too complex and has hitherto baffled solution." This sentence, written in 1892, may well hold true in very large measure thirty years hence unless the effort at present in progress to revise the attitude of the community toward this disease and the basic social problems related to it come shortly to progress with the speed of an effective revolution.

"A complex problem which has hitherto baffled solution," it has impressed me as being, from the time, some seven years ago, when I first came in practical contact with it. It required then no great acumen to realize that it was no problem whose solution could be covered by any simple formula. "Segregation of Prostitutes," "Education of the Public," "Vaccination" (supposing it possible) "Prophylactic Therapeutics," "Enforced Reporting," are, of course, catch phrases, each representing an idea valuable in its time and place, but neither singly nor together capable of solving the problem in other than the idealistic sense. Neither is it a prob-

¹ To those interested in the subject of this paper the recent monographs of Vedder (Syphilis and Public Health) and Stokes (The Third Great Plague) are recommended. They present a general view when at most we emphasize certain details by drawing on our personal experience.

² Practice of Medicine, 1892.

lem for any particular class of specialists in the community, the policeman or the lawyer, the minister or the social worker. Least of all today is it the problem peculiar to the doctor, for the medical problems involved are nearly enough solved for all practical purposes. It is implied by Osler, as quoted above, that it is properly and primarily a problem which is to be solved by developing the responsibility of the "State" for the protection of the citizens (extension of police power), and of recent years certain States of our country have placed rigorous laws on the statute books in recognition of demands of this nature. It is probably fair to believe, however, that the direct preventive value of such police measures is slight and their educational value considerable—as good an illustration as could be constructed of the baffling nature of the problem.

Certainly, then, one can never look forward to any solution of this problem that can be covered by a purely technical formula, whether legal or medical or social in its make-up. Nor does the work of my colleagues in this presentation even hint at any such general solution.

If syphilis is to be eradicated there will be required the combined efforts of all the specialists concerned—educators, physicians, police and sociologists, as the case may be—using their special skill to its fullest powers. More than that, however, a new attitude must be developed toward the situation by all involved in it. Facts must be considered before moral concepts. Sympathy must be substituted for stigma. The forcible but cold idea of "State" responsibility and control must give way to a sincere interest in community welfare. Above all, no dogma that this or that measure will not work (or will do all) is to be accepted. Every reasonable suggestion must be tried—tried often under most discouraging conditions—but not discarded until incontrovertible facts demand it. It is in this light that the following report seems to me to be of real value. An attempt has been made to combine human sympathy and decency in the honest management of individual cases, with the precise methods of scientific study which alone can, in the end, decide as to the usefulness of particular methods of work. Certain of the results encourage the belief that progress is being made, and suggest that the methods employed might well be tentatively adopted by others.

The intimate history of the development of the present clinic for syphilis at the Pennsylvania Hospital contains much that seems to be instructive, throwing light, as it does, on the chaos which prevails in the public consideration of the problem. In 1911 I became connected with the Pennsylvania Hospital as the director of the Ayer Clinical Laboratory. Salvarsan had rather recently (1909–10) been introduced to the medical profession as a remedy for syphilis, from which much was expected. My predecessor in charge of the laboratory (Dr. Warfield Longcope) had completed the careful study of a number of cases of a particular type of heart

disease (aortic regurgitation), had fully confirmed a growing belief that these cases were syphilitic in origin and had administered salvarsan to a number of them for a considerable period. The use of this drug was spreading gradually to other types of syphilitic disease in the hands of other physicians on the staff of the hospital. Because of technical difficulties the preparation of the solution for injection had, necessarily, been carried out in the laboratory rather than in the drug store (of the hospital), and it had also become customary to call on Dr. Longcope and his assistants of the laboratory staff to administer the drug. This work was transmitted to my staff as a legacy.

It impressed me strongly in the beginning that this was no proper work for the laboratory and I made every effort to transfer it to the clinical services, where I thought it properly belonged. A ruling was secured from the staff that salvarsan was to be administered by the resident physicians under the direction of the chief resident. The laboratory undertook to instruct one or more residents in the work in the full expectation that they would transmit their knowledge to their successors, and that we would be relieved of the work. A year or more was gone through on this basis and it was most unsatisfactory. What with an increasing use of the method, repeated calls on the laboratory for administration because the house was over-busy, the necessity of instructing new groups of men as the house staff changed, those departing having failed to instruct their successors; it became apparent that the laboratory staff was giving more time than ever to the injection of the drug. Also the records were scattered and kept according to no uniform system; the cases were treated according to no well-thought-out plan, and altogether much energy was dissipated to no good purpose. In general, in spite of the fact that the administration of salvarsan seemed clearly to be the function of the clinician, it seemed in the practice of this hospital at least to be a definite duty of the laboratory.

When opportunity offered, therefore, steps were taken, based on the recognition of this situation. The ground taken was that it seemed to be most practicable for the laboratory staff to administer salvarsan; also, that it was to the interest of all concerned, particularly for the good of the patients, that whoever administered the drug should be responsible for the complete management of the case during the time it was under this special treatment. The necessity of this arose because it developed that orders might be given and carried out for the administration of a certain dose at a certain time, and it would afterward be discovered that through someone's blunder either the necessary urine and blood examinations had not been called for or mercury had not been stopped (as was then thought advisable), or other mistake had been made through lack of effective supervision. It was therefore agreed that cases regarded by the clinical staff as requiring salvarsan should be referred to the director

of the laboratory for treatment. They were retained in his charge until he felt that salvarsan would accomplish no more, when they were returned to the service from which they came.

It was recognized that the staff of the laboratory was insufficient to enable it to handle the normal increase in the volume of the work, which was clearly foreseen with the growing confidence of physicians in the usefulness of the drug. An additional physician was assigned to the laboratory staff for this and other duties. Dr. Richardson assumed for me the duty of administering salvarsan and took over all contacts with patients. So far the situation had forced the reorganization, and, as was to be expected, under such circumstances no serious difficulty was experienced in carrying the arrangement into effect. The effective feature was the unification of control thus secured, the particular place where responsibility lay being, within reason, an entirely secondary matter. Within reason is used advisedly, and this should be noted particularly.

It is quite unreasonable to have the most important cases of syphilis from the community point of view, that is, the open-active and infectious case in the primary or secondary stage, treated in some out-of-the-way corner by the least thoughtful and most uncouth junior member of the hospital's surgical staff, with little or no supervision or enforced sense of responsibility. This condition has prevailed too long and too often, and one must assume that the professional staff and management of any hospital where this relationship persists not only recognize the prevailing and proper prejudice against this disease as an evidence of immorality, but quite improperly give this prejudice precedence over their clear professional duty to the patient, and particularly to the public health. I regard it, therefore, as perhaps the most important accomplishment of my colleagues, and I include with them in this the management of the Pennsylvania Hospital, that the cases of syphilis are now for the most part seen in consultation and treated in the receiving ward and the adjacent rooms of the main surgical clinic. This change has certainly in no way lessened the repute of the hospital.

At the time these changes were made I had been familiar with the operation of the out-patient clinics of the Henry Phipps Institute, where a modern social service department was active. Such a service when carried on in the proper spirit forms an indispensable bridge between the physician and the patient. It assures a regular and sympathetic contact between the two, that patients present themselves for examination, advice and treatment, and that such treatment as is recommended, whether in the way of drugs or economic adjustment, is actually carried out. At its best and plainly stated the social service makes it possible for the more or less impersonal organization of a hospital to come into those intimately helpful relations with the people, its patients, that is so characteristic a feature of the life and work of the best type of family physician.

Such a department of social service was in successful operation at the hospital at this time in connection with the more general work of the institution. The question arose then naturally as to whether they could successfully assist in the management of syphilis. At the time it appeared to all to be a very serious question, and one the answer to which could not be predicted. Would these patients submit to the questioning, to the advisory activity, to the constant contact in connection with their trouble, often based on immorality, with persons, women, of obvious respectability? In retrospect these questions appear almost laughably childish, based, as they were, upon a complete misconception of the actual humane aspects of the situation. The syphilitic is a sick person, often, if intelligent, a badly frightened and distressed person. He or she welcomes any honest effort to improve matters. Moreover, and more definitely important, perhaps, the youth of today, wild, immoral or unmoral, as one may choose the word, is the man with a family of a year or two hence. And it is but fair to say that the major part of the work of this clinic has, as a matter of fact, been concerned with what may be called a family practice. The unattached professedly or professionally immoral, either male or female, have been in the minority. Such as have come to the clinic have been dealt with in regular course, with no untoward incident, and leave us with no reason to suppose that they are as a class impossible to handle.

In another sense expectation has been agreeably at fault. As the clinic has developed it has become clear that it need not permanently be a large item of expense to the hospital. When starting out there was a large overhead charge proportionately to the number of patients treated, and the effort required and received liberal financial support from the hospital. The principle of charging those who could afford to pay was adopted from the start. Probably a mistake was first made in fixing the basic price too high (\$5 per salvarsan treatment). Later the price was dropped to that of the cost of salvarsan, and it has since been gradually increased. The outcome up to the present is summarized at the end of the report. The very favorable result is partly, no doubt, to be accounted for by the high wage scale of the past two years. There seems to be no reason why a good working balance should not be maintained, however, on a falling scale of wages if the salvarsan is lowered to a reasonable figure based on cost of production.

In the future the State should certainly be expected to furnish salvarsan for such as are actually unable to pay for it. With a widespread organization of such clinics in operation the cost of this item to the State should be more than made up in the relief to general and insane hospitals now forced to care for the preventable late manifestations of the disease. With State aid to cover the charge for drugs to the truly poverty-stricken and the unwilling openly infectious cases, the question of cost still presents certain debatable features which require brief mention:

1. Should the hospital compete with the private physician in this field and undercharge him? The usual minimum fee for the administration of salvarsan in this neighborhood by private practitioners among the working class is \$25 a dose. The consequence is that treatment, if taken at all, is not persisted in. As there seems to be reason to doubt whether the practitioner treating a small number of such cases can really afford to work for a lower fee, it is clear that the hospital method must prevail in the public interest.

2. How is the charge to be decided upon? It appears to us that the charge should be such as to permit the patient to carry out a systematic course of treatment with a distinctly serious effort, but without hardship detrimental to his other vital interests. The calamity is that he should go untreated. It should not cost so little as to seem trivial nor so much as to be unattainable.

3. Is there any good reason why an expensive treatment (salvarsan) should be substituted for an inexpensive one (mercury). Aside from the purely medical questions involved (the greater efficiency of salvarsan in many cases) it has become evident that the more exacting method (salvarsan) interests the patient much more thoroughly, and this is a large factor in persuading him to persist in the treatment. Moreover, the physician himself administers salvarsan and consequently maintains control of the situation. With mercury the patient's energy and intelligent initiative are severely taxed by the prolonged necessity of drug-taking by methods which are often disagreeable. The salvarsan treatment from the community point of view for these reasons is by far superior to mercury.

From the purely medical point of view the report speaks for itself. It cannot be too often emphasized that cure is possible in the earliest stages, that it very soon becomes problematical and finally extremely doubtful whether cure can be attained. Probably no one can state accurately just when treatment should be stopped after it is recognized that cure cannot be accomplished. In view of the serious nature of the late effects of the disease it is probably always safe to advise a little more treatment on some systematic intermittent plan as a preventive for these.

So much for the encouraging aspects of the work of this clinic. The other side of the picture is presented when the number of early cases presenting themselves for treatment is examined. They are few. How to make them more; how, in other words to reach the cases in the primary stages when they are susceptible to cure; how by such early treatment to limit the spread of the disease, this appears to me to be the most fundamental question facing the community in its relation to the management of syphilis. It is probable that the establishment of such clinics as this may in itself be a most effective measure in spreading to the general public the knowledge that treatment must be early if it is to be effective.

Finally, I wish to credit the success of this experiment (for such it has been) to the devotion and common sense displayed by Mrs. M. J. MaGee at the head of the social service department, and her assistants, successively, Miss C. G. Ashbrook, Miss B. W. Thatcher and Miss J. R. Null, and to the scrupulous attention to simple duty manifested by my colleagues, Dr. Richardson and Dr. Newcomer. Such a venture can only succeed in my opinion when character is given every chance to take its place as opposed to ignorance and careless self-will.

It is also a pleasure to recognize that our effort was preceded by the work of the Massachusetts General Hospital, Boston. My colleagues have had to meet this local problem in their own way, but the fact that a previous clinic conceived in the same spirit was in successful operation has cleared our path of many obstructive doubts.

ORGANIZATION AND MANAGEMENT OF THE CLINIC (Newcomer). The syphilis patients are handled with the aid and coöperation of a social service worker. She devoted her whole time to the immediate direction of the patients and to following them up. The physician sees the patients at one dispensary period during the week and administers salvarsan on Saturday afternoon. The dispensary period is largely taken up with new cases and with a few old cases coming for more or less extraneous advice. On Saturday afternoon, besides receiving salvarsan, the patients are interviewed, progress of symptoms noted and mercury treatment prescribed.

The success of the clinic depends upon the regularity with which the patients come for their injections. The patients initially come largely from the various dispensaries of the hospital, referred by them to the social service department. The social service department actively interests itself in seeing to it that the patients are so referred. It is necessary to instruct and convince the patients as to the necessity of prompt and regular treatment, to look them up when they fail to appear, to give advice and encouragement, to investigate and perhaps organize their financial affairs so that they may pay for the salvarsan, to help them with the many extraneous problems which they may present. This advice and interest in the economic and social welfare of the patients reacts to increase their interest in and respect for us, so that they often come for advice and help on matters in no way related to their disease, developing a very real confidence in our motives and in our services.

Our clinic reaches for the most part a certain type of patients who, under the present condition of the labor market, are fairly well off, and who are rather respectable members of the community. A good many of them are single men working in and about Philadelphia who come to the dispensaries of the hospital for treatment for various minor ailments which are diagnosed as syphilitic. Relatively few of them are single women, about one-fourth of them are married

women, usually wives of other patients. Only very occasionally have we had professional prostitutes as patients, probably because that class is getting very little treatment. Of the few that we have had some have become quite regular patients. The majority have come two or three times and then stopped and we have lost track of them. The prostitute is, of course, the type of patient who should be treated. Why they do not receive treatment is not clear. The very poor, if also syphilitic, are usually physical wrecks and their social, economic and mental condition is on such a low level that nothing can be done with them. They are lazy, indifferent, hard to keep track of and usually soon disappear from observation. Unless they are infectious it often seems a waste of time to try to do much for them. We have, on the whole, very little difficulty in persuading those to take salvarsan who really should have it, and most of the patients represent a definite economic asset to the community.

The patients belong largely to the laboring class. They have only moderate incomes. They pay \$3 a dose for the salvarsan. This has recently been increased to \$4, in view of the prevailing high wage scale. None of us feels, after several years' contact with the problem, that the cost of the salvarsan is any real hardship to them. It is low enough so that they can pay for it month after month; it is high enough so that it is a sufficient sacrifice to enhance the value of it to them. We feel that a cheaper salvarsan, as could be dispensed by an endowed clinic, would not bring either a large number of patients or work greater good among those we have. They would tend to value the treatment less highly and come less frequently.

We give salvarsan free or at reduced cost to those who actually cannot pay, the free service making about 10 per cent. of the whole. These free patients are the least constant and faithful of our patrons.

The patients, as has been said, come largely from the dispensaries of the hospital and a large number of them continue to attend the dispensaries from which they first came. We, therefore, keep the records of these dispensaries continually up to date as regards the antisypilitic treatment which we are giving to their patients in the salvarsan clinic.

An effort is made to have all new patients who come to the hospital and are referred to the laboratory for a Wassermann listed on our cards so that they can be followed up by our social worker. Those patients who appear at the hospital in an infectious condition are given neosalvarsan immediately by the intern in charge.

Those patients who are to receive salvarsan treatment obtain in advance from the social service worker a numbered and timed slip entitling them to the treatment, and it is administered to them in the order of these numbers. An effort is made to keep the patients waiting as little as possible and to arrange the time of injection so

as to be as convenient for them as possible. With exceptions the patient goes home immediately after receiving the treatment.

Administration of Salvarsan. The patient lies on an ordinary operating table provided with an arm-rest and receives the injection, usually in a vein of the arm, by the gravity method. An ordinary funnel and rubber tube fitted with a platinum needle is used, the funnel being suspended in a bracket from the ceiling. Three such tables are kept going at once. One nurse assists with the administration of the salvarsan while another boils the funnels and needles between patients. The records are kept up and accessible by a stenographer at a nearby table.

It has never been found necessary to cut down on the patient's vein; very occasionally it is necessary to ask the patient to return again for another trial. The needles are left in position in the vein without holding during the injection, they being freely inserted and the tubing disposed so that it lies without pulling on the needle. Long experience has shown us that a nurse cannot be trusted to hold a needle steady in a vein. She will unconsciously shift it through or out. No trouble is now experienced with subcutaneous infiltration of the salvarsan.

In order that one man may administer the drug to 50 to 70 people in an afternoon we have the salvarsan made up in quantities of about 20 doses at a time. This is done in a little room arranged for the purpose, equipped with scales, still, etc. The mixing is done by weight in "pyrex" flasks. The contents of a given number of ampoules are dissolved in freshly distilled water, and $2n\text{NaOH}$ is added from a burette until the precipitate is completely redissolved, a record being kept of the amount used. This averages 0.71 to 0.72 c.c. $\frac{N}{1}$ NaOH per 0.1 gm. salvarsan. The dissolved material is then made up to a volume of 30 c.c. per 0.1 gm. salvarsan by the addition of normal salt solution. We have lately changed the salvarsan mixing so that 0.85 c.c. $\frac{N}{1}$ NaOH is added per 0.1 gm. salvarsan and the whole diluted to 50 c.c. per 0.1 m. salvarsan. At injection the dose is measured out in a graduate, the size of the dose depending on the weight of the patient, condition of the kidneys and previous reaction to the drug.

Our routine is to give the patient a full dose of salvarsan once a week. Some patients are unable to come so often. We do not like to give it less frequently than once in two weeks. Wassermann reactions are made every seven doses and treatment continued for three times after a negative Wassermann, the Wassermanns being repeated frequently during the following year. Mixed treatment is prescribed throughout along with the salvarsan.

Results of Treatment. The treatment of the patients has been ordered with the view of giving salvarsan continuously, week after week, with the hope of thus securing a permanently negative Wassermann. We originally adopted this routine in the treatment of

sypilis because of the fact that we had had some success with it at the time our clinic was run on a much smaller scale, and there seemed to be some theoretical considerations in favor of it. For convenience of the discussion of our results in the treatment of sypilis the patients are grouped into different classes.

The first class of patients to be considered consists of twenty-six individuals who have had over twenty doses of salvarsan, some of them much more than this. Table I gives the doses which they have received and the Wassermanns which have been made upon them. Our mercury treatment has been, for various reasons, beyond our control, very irregular, although it was intended that it should continue parallel with the salvarsan treatment. At the top of the column is given a brief statement of the character of the disease for the particular patient. In analyzing the results of this table the most striking feature is the relatively poor results which have been obtained in most cases so far as the Wassermann reactions are concerned. In only the first and last is it likely that the Wassermann reaction is permanently negative. The first patient may never have had sypilis and the last commenced treatment soon after getting his initial lesion. The Wassermann reaction on patient No. 2 has oscillated so much that it is difficult to form any judgment as to his future. In most of the patients the Wassermann reaction varies from time to time, being occasionally negative or weakly positive, but, withal, remaining essentially positive. In most cases the patient's physical condition was very much improved early in the course of the treatment. While these patients may be, in a sense, obstinate cases, they are selected for the large amount of salvarsan they have had rather than for their clinical condition. Except in the case of individuals with early chancres, there are no patients having had less treatment who have become permanently negative. The group, as a whole, therefore, illustrates one of two things: either that in the majority of instances sypilis is very difficult to cure, *i. e.*, in which to produce a permanently negative Wassermann or the method of treatment has not been the most efficacious.

A second group of patients consists of twenty individuals who have had more than ten doses of salvarsan fairly continuously week after week. An analysis of them is given in Table II. It will be seen that as far as the Wassermann reaction is concerned very little is as yet accomplished with these patients. The belief is quite widespread that a moderate number of doses of salvarsan constitutes an adequate treatment for sypilis. These patients illustrate how little can be done with such an amount of salvarsan. Not only do they usually retain a positive Wassermann, but it is our experience that they almost always come back within a year or so with fresh symptoms of the disease, provided they stop at this stage of the treatment. In fact, this amount of salvarsan is usually inadequate even when commenced in the early stages of sypilis.

TABLE I.—THE TREATMENT AND WASSERMANN REACTIONS ON CERTAIN PATIENTS WHO HAVE HAD MORE THAN TWENTY DOSES OF SALVARSAN.

Patient.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Lesion.	Non-luetic.	Chancre.	Secondaries.	None.	Cerebrospinal lues.	None.	Gumma.	None.	None.	Periostitis.	None.	None.	None.	None.	Secondaries.	Cerebrospinal lues.	Cerebrospinal lues.	Mucous patches.	Mucous patches.	Leg ulcers.	Mucous patches.	Tuberc dorsalis.	Tertiary skin lesions, macular.	Mucous patches.	Secondaries.	Chancre.
Previous dose.	11	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	°6	°3	3	3	5	3	4	4	3	3	3	4	3	3	4	5	3	4	3	3	4	4	3	4	4	°5
2	3	3	3	..	5	..	..	..	3	5	3	3	..	5	3	..	..	..	..	5	5	..	5	5
3	4	4	..	6	5	..	..	4	3	..	3	3	6	6	3	4	5	..	..	5	5	6	6	6
4	3	..	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
5	4	3	5	5	5	..	..	5	3	5	3	3	6	6	4	6	6	6	6	6	6	6	6	6
6
7
8	3	3	..	5	5	..	4	5	3
9	4	3	5	6	6	3
10	3	3	5	6	4	6
11	5	6	4	6
12	3	..	6	4	5
13	3	..	6	4	6
14	5	3	4	6	4	6
15	5	3	6	6	5	6	4	5
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The figures of the table indicate decigrams of salvarsan. A zero (°) before the figure indicates a negative Wassermann, a single dot (·) a one or two plus, and a double dot (:) a three or four plus Wassermann. Figures in first vertical column show time in weeks.

TABLE I—*continued.*

Patient.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Lesion.	Non-luetic.	Chancre.	Secondaries.	None.	Cerebrospinal lues.	None.	Gum a.	None.	None.	Perios itis.	None.	None.	None.	None.	Secondaries.	Cerebrospinal lues.	Cerebrospinal lues.	Mucous patches.	Mucous patches.	Leg ulcers.	Mucous patches.	Tabes dorsalis.	Tertiary skin lesions, macular.	Mucous patches.	Secondaries.	Chancre.
Previous dose.	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
51	6	3	..	..	6	..	..	..	..	..	..	..	..	6	3	..	..	..	..	..	3	..	..
52	6	..	..	..	5	..	..	..	..	..	..	..	..	6	..	..	..	..	..	..	3	..	..
53	6	6	..	..	3	6	4	..	..	..	..	..	..	..	5	..	..	4	..	..	..	..	..	..
54	6	..	..	..	3	6	4	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..
55	6	..	..	..	3	5	4	..	..	4	..	..	..	..	5	..	..	4	..	..	..	4	..	..
56	6	5	..	..	3	5	4	..	..	6	..	..	..	..	6	..	..	5	..	..	..	3	..	..
57	6	6	4	..	..	4	..	..	..	6	..	..	..	..	..	4	..	..	..	..	..	..	..	..
58	6	6	..	..	..	5	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59	..	6	..	6	..	..	..	5	..	..	..	6	..	..	5	..	..	..	..	..	..	..	..	5	..	..
60	..	6	6	..	3	..	..	5	4	..	..	4	..	..	..	..	..	3	..	..	..	..	..	3	3	..
61	..	6	..	5	3	..	..	5	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	6	..	..	..	..	..	6	4	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..
63	..	6	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	3	..	..
64	..	6	6	..	3	..	..	6	4	..	..	..	..	..	5	..	..	..	..	..	..	..	..	4	..	..
65	..	6	..	..	..	..	..	5	4	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..
66	..	6	..	6	..	..	..	6	3	..	..	..	..	..	6	..	..	3	..	..	..	..	..	..	..	..
67	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
68	..	6	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..
69	..	6	..	..	..	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
70	..	6	..	..	..	..	..	..	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
71	..	6	..	..	..	..	..	5	3	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
72	..	6	..	..	5	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
73	..	6	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
74	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
75	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
76	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
77	..	6	6	..	..	..	..	6	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
78	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
79	..	6	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..
80	5	..	..	..	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..
81	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
82
83	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
84	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
85	6	..	..	..	..	..	5	..	..	..	..	..	..	..	..
86	6	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..
87	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..
88	6	..	..	..	6	..	..	..	..	..	..	..	..	..	..	..	..	..	..

The figures of the table indicate decigrams of salvarsan. A zero (°) before the figure indicates a negative Wassermann, a single dot (·) a one or two plus, and a double dot (:) a three or four plus Wassermann. Figures in first vertical column show time in weeks.

Table III gives a summary of the treatment of eighteen individuals with chancres, or who have recently had chancres, and who have received ten or more doses of salvarsan. Of these patients the first seven are probably permanently negative, a result that may be considered as good. The remaining eleven might be considered as standing henceforth clinically on the same basis as the patients of Table I. It is not clear why patient No. 9 did not get a permanently negative Wassermann, nor, indeed, that it may not be negative. In the case of patient No. 13 and perhaps No. 14 also

there may have been a mistake as to the age of the chancre. The condition of patients No. 17 and No. 18 is not clear. It is possible that in case the patient has a chancre, and has neither developed a positive Wassermann nor a systemic infection, ten doses constitutes an adequate treatment. We do not often get patients this early. As a whole this group of patients illustrates quite forcibly the fact that ten doses of salvarsan are not an adequate treatment for early syphilis.

TABLE II.—THE TREATMENT AND WASSERMANN REACTIONS ON CERTAIN PATIENTS WHO HAVE HAD MORE THAN TEN DOSES OF SALVARSAN.

Patient.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Lesion.	Secondaries.	Pains.	Periostitis.	Gumma.	Gumma.	Chest pains.	Optic atrophy.	Pains; nephritis.	Vitreous degeneration.	Leg ulcers.	?	Mucous patches.	Mucous patches.	Gumma.	Cholecystitis.	Joint pains.	Periostitis.	Periostitis.	?	Weakness.
1	3	3	4	5	3	4	3	3	4	4	4	3	3	3	3	3	4	3	4	4
2	3	4	5	5	4	5	5	3	5	5	5	4	5	5	5	5	5	5	5	5
3	3	5	4	5	5	5	5	3	5	6	6	5	5	6	4	5	5	5	6	6
4	3	6	5	5	5	5	5	3	5	6	6	5	5	6	5	5	6	5	6	6
5	3	4	5	5	5	5	5	3	5	6	6	5	5	6	5	5	6	5	6	6
6	3	5	5	4	5	5	5	3	5	6	6	5	5	6	5	5	6	5	6	6
7	3	5	5	5	5	5	5	3	5	6	6	5	5	6	5	5	6	5	6	6
8	5	5	6	5	4	5	5	3	5	6	6	6	3	6	5	5	5	5	6	6
9	5	5	6	5	5	5	5	3	5	6	6	6	3	6	5	5	5	5	6	6
10	6	5	5	5	6	5	5	3	5	6	5	6	3	6	5	5	6	4	6	6
11	4	6	5	5	5	6	5	4	5	6	3	6	3	6	5	5	5	5	6	6
12	6	5	5	5	5	6	5	5	5	6	3	6	3	6	5	5	5	5	6	6
13	6	6	5	5	6	6	5	5	4	6	3	6	3	5	5	5	5	5	6	6
14	4	6	5	5	5	6	4	5	4	6	5	6	3	5	5	5	5	5	6	6
15	6	6	5	5	4	6	6	5	5	5	4	6	3	5	5	5	6	5	6	6
16	6	6	5	5	6	6	5	5	5	5	5	5	5	5	5	5	4	5	5	6
17	5	5	5	5	6	6	5	5	4	5	5	5	3	5	5	5	5	5	5	6
18	6	5	5	5	5	5	5	5	5	5	5	5	3	5	5	5	4	5	5	6
19	5	5	5	5	5	5	5	5	5	5	5	6	3	5	5	5	5	5	5	6
20	5	6	5	5	6	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
21	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
22	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
23	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
24	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
25	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
26	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6
27	5	6	5	5	5	6	5	5	5	5	5	6	3	5	5	5	5	5	5	6

The figures of the table indicate decigrams of salvarsan. A zero (°) before the figure indicates a negative Wassermann, a single dot (·) a one or two plus, and a double dot (:) a three or four plus Wassermann. Figures in first vertical column show time in weeks.

As a result of an analysis of these cases we can draw several conclusions: It is quite obvious in the first place, that the treatment of syphilis must be extended over a considerable period of time if it is to produce permanent results. In view of the fact that the general experience of syphilographers has tended to show somewhat better results than those that we are able to publish, we have come to the conclusion that our method should be modified, at least until we demonstrate that a new modification does not produce any better

results. Accordingly, instead of giving salvarsan continuously as long as the patient will consent to it we are now giving six doses of salvarsan, one each week, and following this course of six doses with a course of ten weeks of mercury treatment, preferably the inunctions. These periods of salvarsan treatment and mercury treatment are to be alternated continuously until a permanently negative Wassermann is secured and for one year thereafter. We have already found under this regime that it is more difficult than formerly to retain the interest of the patient.

TABLE III.—PATIENTS WITH RECENT CHANCRES, SOME OF WHOM HAD NOT YET HAD SECONDARIES.

Patient.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Age of chancre in wks.	14	6	8	8	3	12	8	3	1	4	8	8	2	3	10	12	3	4
Secondaries.	+	0	0	0	0	+	0	0	0	0	+	+	0	0	+	+	0	0
1	:3	:3	:4	:4	°3	:3	:3	:3	°3	:3	3	:4	:3	:3	:4	°3	:4	4
2	3	5	5	5	5	4	4	4	5	5	6	3	5	5	6	:5	5	5
3	5	5	5	5	5	5	3	4	6	6	6	3	5	5	6	5	5	5
4	3	6	5	:5	5	4	3	5	5	5	6	3	5	5	6	5	5	5
5	3	6	5	6	6	4	3	4	6	6	6	3	5	5	4	5	5	6
6	4	6	..	6	5	4	3	4	..	..	6	3	5	5	6	4	5	6
7	5	..	5	4	5	3	5	5	6	..	6	5	5	5	°5	4	3	6
8	4	4	°5	:6	4	4	4	°5	6	5	5	4	:6	..	:5	..	°6	°5
9	5	..	5	..	°6	4	..	6	6	..	5	°6	6	6	..	°5	°6	..
10	°5	..	5	..	..	5	5	6	°6	..	6	..	6	6	..	..	6	..
11	..	..	5	..	..	4	5	5	..	..	6	..	6	6	..	..	5	..
12	..	°6	2	..	..	°3	5	5	°6	..	°6	..	6	6	..	..	6	..
13	°6	6	6	..	..	4	5	..	..	..	°6	..	6	6	..	..	6	..
14	..	3	6	..	..	°4	..	6	°4	..	6	..	..	6	..	5	°6	..
15	..	..	°6	..	..	..	..	..	..	..	°6	..	..	6	..	..	..	°5
16	..	..	4	..	..	..	..	°6	..	..	..	..	°6	6	..	..	..	6
17	..	..	°6	..	..	..	..	5	°6	..	..	..	°6	6	..	..	..	°6
18	..	3	..	..	..	°	°	°6	..	..	..	..	6	6	..	..	..	..
19	..	..	..	..	..	..	..	°	..	..	..	..	6	6	..	..	..	..
20	..	..	..	..	..	..	..	°6	°6	..	..	..	4	5	..	..	..	..
21	..	..	6	..	..	°	..	°6	..	4	..	..	5	6	..	..	..	..
22	..	5	..	..	..	..	..	..	..	5	..	..	..	..	..	..	..	..
23	..	..	..	..	..	..	..	°6	..	..	..	..	5	..	..	..	..	..
24	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
25	..	..	..	..	..	..	..	°	..	..	..	..	5	..	..	..	..	..
26	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
27	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
28	..	4	..	..	..	..	°	..	..	..	..	..	..	..	..	..	..	..
29	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
30	..	°6	..	..	..	..	..	..	..	..	..	..	..	°5	..	..	..	°5
31	..	..	..	..	..	..	..	..	..	..	..	..	..	5	..	..	..	..
32	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..
33	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..
34	..	..	..	..	..	..	..	..	..	:5	..	..	..	:6	..	..	..	..
35	..	4	..	..	..	..	..	..	..	5	..	°6	..	6	..	..	..	..
36	..	..	..	..	..	..	..	..	..	..	..	°5	..	6	..	..	..	..
37	..	..	..	..	..	..	..	..	..	..	..	..	..	6	..	..	..	..
38	..	..	..	..	..	..	..	..	..	..	..	..	..	:6	..	..	..	..
39	..	..	..	..	..	..	..	..	..	..	..	..	..	°6	..	..	..	..
40	..	..	..	..	..	..	..	..	..	..	..	..	..	°6	..	..	..	..

The figures of the table indicate decigrams of salvarsan. A zero (°) before the figure indicates a negative Wassermann, a single dot (·) a one or two plus, and a double dot (:·) a three or four plus Wassermann. Figures in first vertical column show time in weeks.

TABLE IV.—LUETIC PATIENTS IN WHOM THERE WAS A CONSIDERABLE VARIATION IN THE WASSERMANN REACTION AS DONE FROM TIME TO TIME AND BY DIFFERENT METHODS.

Date.	Dose.	Wassermann reaction.			Date.	Dose.	Wassermann reaction.		
		Cholesterinized antigen.		Noguchi.			Cholesterinized antigen.		Noguchi.
		1 c.c. serum.	2 c.c. serum.				1 c.c. serum.	2 c.c. serum.	
Patient No. 1.					Patient No. 2.				
Feb. 2, '15	3	++++			Mar. 9, '19	3	++		
14, '15	4				16, '18	4			
Sept. 4, '15	..	0			23, '18	5			
Feb. 15, '16	4				30, '18	3			
Sept. 9, '16	..	++++			April 6, '18	6			
Feb. 10, '17	5				13, '18	5			
Oct. 21, '17	..	++			20, '18	6			
Jan. 12, '18	4				May 11, '18	6			
Jan. 19, '18	5				18, '18	4	0		
Feb. 2, '18	4				23, '18	6			
9, '18	5				June 1, '18	3	++		
16, '18	5				8, '18	6			
23, '18	5				15, '18	6			
Mar. 9, '18	..	++			22, '18	6	0		
16, '18	5				29, '18	6	++++		
23, '18	5				July 6, '18	6	+	....	0
30, '18	5				13, '18	6	+++		
April 13, '18	5				20, '18	6	++++		
20, '18	5	++			27, '18	6	++		
May 4, '18	5	++			Aug. 3, '18	..	++	....	++
June 1, '18	6	++++							
22, '18	5	++++	....	+++				
Patient No. 3.					Patient No. 4.				
June 29, '18	4				June 21, '17	3	++++		
July 6, '18	5	0		0	Aug. 11, '17	3			
13, '18	6	++	++++		18, '17	3			
20, '18	6	+++			Sept. 15, '17	3			
27, '18	5	+			Oct. 6, '17	5			
Aug. 3, '18	6	++++	....	+++	27, '17	5			
10, '18	5	+	....	0	Nov. 17, '17	5	0		
17, '18	6	+	....	0	28, '17	..	0		
					April 15, '18	..	0		
					Aug. 17, '18	..	++		++++
Patient No. 5.					Patient No. 6.				
June 30, '13	..	+++			July 13, '18	4	++++		
Feb. 3, '14	..	++			10, '18	5	++++	....
16, '14	6	++++			27, '18	5			
Mar. 23, '14	6				Aug. 3, '18	5			
July 16, '14	6				10, '18	5	++++	....	0
Sept. 9, '14	..	++++			17, '18	5	++++	....	0
Dec. 12, '14	..	+++							
Feb. 13, '15	..	++++							
April 20, '16	..	0							
Aug. 10, '16	4								
Mar. 7, '17	..	++							
May 26, '17	..	++							
June 28, '17	3				June 22, '18	4			
July 19, '17	3				29, '18	5	++++		
Sept. 15, '17	3				July 6, '18	6	++++		++++
Oct. 27, '17	4				13, '18	6	+	++++	
Nov. 17, '17	5				20, '18	6	+++		
Dec. 15, '17	6				27, '18	6	0		
Jan. 19, '18	6				Aug. 3, '18	6	++	....	0
Mar. 16, '18	4				10, '18	5	+	....	0
April 27, '18	5				17, '18	5			
May 11, '18	5				24, '18	..	0		
July 6, '18	5	++	....	0					
27, '18	..	++							

TABLE V.—PATIENTS IN WHICH A POSITIVE WASSERMANN IN CONNECTION WITH THE CLINICAL PICTURE LED TO PROBABLE MISTAKE IN DIAGNOSIS, CHOLESTERINIZED ANTIGEN.

Patient.	1	2	3	4	5	6	7	8	9
Diagnosis.	Leg ulcers.	Epilepsy.	General pains.	Dizzi- ness.	Perfor- ated septum.	Heredi- tary lues.	?	Blood donor.	Deaf- ness.
1	:3	:3	:3	:4	:3	:4	:3	:4	:3
2	5	4	4	..	3	5	4	4	
3	..	5	5	5	3	4	3	4	5
4	..	5	5	..	4	..	4	4	6
5	5	5	4	5	5	5	4	..	5
6	..	5	4	5	5	5	4	6	
7	6	..	3	5	5	5	4	..	5
8	6	5	3	6	5	..	4	..	5
9	6	5	4	6	5	..	5	6	5
10	6	5	5	..	6	..	6	5	5
11	6	6	5	:5	..	5	..	..	5
12	..	6	5	..	..	..	..	..	5
13	6	..	..	:6	..	5	..	..
14	5	..	..	..	..	..	..	..	5
15	6	..	..	..	..	5	o	..	5
16	..	..	o	6	..	..	..	..	5
17	6	..	..	..	..	..	..	4	
18	6	..	..	..	..	..	..	4	
19	5	..	..	..	..	5	..	o	
20	..	..	o	..	..	..	o	o	o

The figures of the table indicate decigrams of salvarsan. A zero (°) before the figure indicates a negative Wassermann, a single dot (·) a one or two plus, and a double dot (:) a three or four plus Wassermann. Figures in first vertical column show time in weeks.

TABLE VI.—THE ECONOMIC STATUS OF TWELVE PATIENTS AS INFLUENCED BY THE ADMINISTRATION OF SALVARISAN.

Patient.	Maximum earning capacity per week.	Duration of incapacity, weeks.	Weeks of treatment to remove incapacity.	Cost of time lost during incapacity.	Cost of treatment to date of resuming work.	Amount which could have been saved by prompt treatment.	Time in weeks which could have been saved by prompt treatment.	End-result.
1	\$25	8	4	\$200	\$12	\$88	4	Loses a day occasionally.
2	30	5	2	150	6	84	3	Works regularly.
3	35	3	3	280	9	66	5	Works regularly.
4	25	12	3	300	9	216	9	Works irregularly.
5	20	5	2	100	6	54	3	Works regularly.
6	25	6	3	150	9	66	3	Works regularly.
7	15	8	2	120	6	84	6	Works regularly.
8	25	4	2	100	6	44	2	Works regularly.
9	35	3	1	105	3	67	2	Works regularly.
10	38	3	1	114	3	73	2	Works regularly.
11	35	4	2	140	6	64	2	Works regularly.
12	18	12	2	216	6	174	10	Works regularly.
Total	\$326	78	27	\$1975	\$81	\$1080	51	

It is a very difficult thing to judge about the results of treatment unless a large number of cases are before one, a larger number than we here have at our disposal. If one regards the results of syphilis work from month to month and considers only small groups of patients, various impressions are received as to the results obtained. At times there will be several patients who have had a reasonable amount of salvarsan who, for some reason or other, are coincidentally negative. But if a few months are allowed to go by one is usually disappointed by having the negative Wassermanns on these patients return to positives.

Everyone knows how quickly salvarsan clears up certain luetic lesions, more particularly those of the surfaces covered by epithelium. Except in the cases of *tabes dorsalis* we have never given salvarsan over any considerable period without an appreciable improvement in the clinical picture. This fact should be borne in mind when reviewing the not very encouraging serological results of the tables.

SYPHILIS AND PREGNANCY (Richardson). During the past two years' treatment of syphilis at the Pennsylvania Hospital there have come under observation 12 syphilitic women who were pregnant at the time or who soon became pregnant. Of the 12, 9 had a history of miscarriage previously. The number of miscarriages varied from one in one case to four in several cases. The diagnosis was based on the history of miscarriages and positive Wassermann tests in both the patient and the patient's husband, together with a history and physical signs of syphilis. Only one case failed to show a positive Wassermann, and in this the physical examination and outcome of treatment made the diagnosis certain.

The 3 cases without history of miscarriage had not been pregnant before. All, however, had a clear history of syphilis, including a positive Wassermann test.

Of the 12 cases, 6 were treated during pregnancy and 6 before pregnancy had commenced.

The treatment varied in dosage from one dose of 0.6 gm. of neosalvarsan to several of neosalvarsan and salvarsan, most of the cases receiving a total of about 1 gm. of salvarsan divided among two or three doses.

In most of those treated during pregnancy the treatment was given before the fourth month. However, in one case seven months' pregnant when first seen and with a history of four miscarriages and stillbirths, treatment was given without any bad results.

All of the cases treated progressed to full term. Those who were not pregnant at the time of treatment became so within a year. Normal children were born to all of the patients treated. These children were examined and in several Wassermann tests done, all being negative. They have been seen occasionally since birth and no case of syphilis has yet developed among them.

The condition of the mothers improved with treatment, though several still showed signs of syphilis, with positive Wassermanns even after the birth of apparently normal children.

SALVARSANS AND SALVARSAN REACTIONS (Newcomer). Our salvarsan experience has been sufficiently large to give some accurate data on the question of salvarsan reactions and the involved question of the toxicity of the various salvarsans on the market. During the past year we have given three thousand doses and have had quite varied experience with reactions.

Nausea and vomiting, following immediately or several hours after the administration of salvarsan, is the most common reaction. It is usually supposed that this reaction is in large part inhibited by having the intestinal tract empty. While this seems to help with some there are others with whom it certainly does not help. The most efficient way of preventing this reaction is the slow administration of salvarsan. We ordinarily give salvarsan so that the injection is completed in two or three minutes. If it be allowed to take ten to fifteen minutes, patients seldom have nausea.

Anyone with any considerable experience has seen the so-called "nitroid" reaction, occurring after about 0.2 or 0.2 gm. has been given. The patient becomes dyspneic, has a very considerable fear of death, with a sensation of drowning, the pulse becomes feeble and rapid, the face becomes quite flushed, followed in a few minutes by a very marked pallor, with cyanosis about the lips and sometimes with considerable edema of the face. Edema of the lungs probably occurs, but is not considerable. There is sometimes laryngeal involvement, with dysphagia. The patient usually recovers quite rapidly, often feeling much better in fifteen to thirty minutes, but looking pale and sick for several hours afterward. The reaction sometimes has the appearance of being very serious. We have seen the reaction followed by relapses, the patient going through the same cycle several times hour after hour. We have never seen a serious ending.

There is a peculiar reaction which sometimes occurs following the administration of salvarsan, evidenced by intense pain across the sacral region, pain which is not eased by any position and which is exaggerated by movement. The pain has usually disappeared within a half hour. It is presumably vasomotor in its origin.

There is a local reaction of the veins used for injection, which is fairly common and sometimes important. Sometimes when one is injecting salvarsan into a vein which lies for a considerable distance superficially in the skin, the vein will be seen to contract throughout its entire length and become like a whipcord. The salvarsan ceases to flow and the condition continues for some time. Under some not very well-defined circumstances this contraction remains and is followed by thrombosis. The thrombosis may occur without the contraction having been specifically noticed. The patient

usually feels some pain, often referred to the shoulder, and during the following week the arm is painful along the course of the vein. This thrombosis, while it involves only the veins of the arm, may be very extensive, especially if attempts at injection are made in several veins. The reaction may be more localized than above described and involve a short segment of the vein only. Localized thrombosis certainly sometimes occurs, due to injury to the vein because of faulty technic; but the reaction undoubtedly occurs when injury to the veins is out of the question, when the vein is large and free and the needle small and sharp. It occurs more frequently as the amount of NaOH in the salvarsan solution is increased. It is more common in colored people than in white people, and it is at times impossible to continue to give them salvarsan because of this reaction.

In those patients who repeatedly have the anaphylactic "nitroid" reaction it is usually the case that neosalvarsan does not produce such a reaction, and may therefore be given instead of the salvarsan. It is probable that neosalvarsan does not produce venous thrombosis to the same extent as salvarsan, and in fact tends to be the only form in which the drug may be given repeatedly to negroes.

Salvarsan sometimes causes a dermatitis of rather serious character. A day or two after the injection there appears a reddened scaly lesion which itches considerably. The lesions are macular, with some thickening of the skin. The superficial layers peel off and give a fine scale. Sometimes the lesion is less sharply defined, consisting of a diffuse thickening and reddening of the skin.

The lesion may appear any place: on the ears, on the back of the hands, on the face, on the shoulder or very extensively over the body. It is very irritating, and if scratched can become secondarily infected.

The lesion usually develops only after very considerable salvarsan treatment. Sometimes treatment can be continued for some time without the lesion any more than continuing as an unimportant affair. But at any time the lesion may become so extensive as to be very serious and even to menace life itself. Further, a mild lesion may slowly become progressively worse in spite of salvarsan having been discontinued. While infrequent this skin reaction constitutes the most serious obstacle to the continued administration of salvarsan, excepting only venous thrombosis in the negro, which we have described above.

We should mention here the question of nephritis as related to salvarsan reactions. In the past we have had two deaths following the use of salvarsan, and due primarily to a salvarsan nephritis. Within a few hours after administration of salvarsan the patient gets all the symptoms and signs of severe acute nephritis. If he dies from the nephritis it usually is a matter of four or five days.

There is, however, another form of death, more specifically salvarsan in character, which is accompanied by cerebral symptoms, by paralysis of various sorts and in which the nephritis picture is not so prominent. The reaction is apparently caused by or at least aggravated by the retention of salvarsan, due to the presence of a coincident nephritis, whatever may be the cause of the latter. It is impossible to tell when reactions of this type are going to occur. They are certainly very rare. It would seem very probable that they are dependent upon some type of kidney lesion involving a very definite set of kidney cells, perhaps even more specifically so than is the case with mercury-poisoning. At any rate the presence of a demonstrable nephritis, even a very severe nephritis, is no indication whatever that this reaction is going to occur, and when it does occur it does so usually in patients who have only a rather insignificant chronic nephritis. We have given salvarsan repeatedly time after time during the last year to patients with chronic nephritis without any trouble whatever. Several years ago we carried on kidney functional tests, calculating McLean's coefficient for urea and NaCl excretion, both before and after giving salvarsan, in the case of about ten individuals having slight kidney lesions, without noticing any change in the coefficients before and for several days after injection.

There is, as a further question, the relation of these various reactions to the make of salvarsan which is used. During the past year we have used about equal quantities of the H. A. Metz salvarsan, arsenobenzol, Poulneç Frères, and arsenobenzol of the Dermatological Research Laboratories, Philadelphia. These salvarsans possess quite obvious physical differences. The New York salvarsan is usually quite dark in color and relatively soluble. The arsenobenzols are light in color. The French is quite soluble. The present Philadelphia Polyclinic preparation is quite insoluble. None of them is as light as the original salvarsan. Aside from their differences in color and solubility they behave very much alike. Certain lots of any of these salvarsans are occasionally poor in the sense that they contain insoluble elements clouding the solution. What pharmacological effect these impurities may have is a subject upon which we have no information. We have the impression that the original salvarsan keeps better after it is mixed than do the present salvarsans. Any salvarsan keeps very well for several hours, and even for half a day, provided it practically fills a clean flask. If the salvarsan be placed in a flask which has become soiled through its use for several hours as a salvarsan container it deteriorates much more rapidly, the oxidation process having been previously started.

Salvarsan has the reputation of being very easily oxidizable as a powder, a reputation which is probably exaggerated. In the manufacture and tubing of the salvarsan there is abundant opportunity for oxidation to be initiated and, to a slight extent, to continue. The salvarsan is dried in an atmosphere of carbon dioxide rather ineffi-

ciently maintained. It is, however, transported, weighed and tubed in the ordinary air, and it is only after quite a few hours that the ampoules are exhausted and filled with CO_2 . The differences in color of the salvarsans are certainly not due to oxidation. Manufacturers state that they are due to the differences in raw products which they are compelled to use, impurities being carried over which give it the color and which it is impossible to remove. Salvarsan is very toxic under some conditions, sufficiently so to produce death in ordinary doses. That these deaths or reactions are essentially due to the particular salvarsans used is open to doubt. Variations in the toxicity of salvarsans do occur, but some other factor than these variations must be responsible for the wide variations as observed clinically. Every once in a while for some unknown reason, probably often not connected either with the preparation or administration of salvarsan, the drug causes death. As a coincidence which the laws of chance always allow, there may be several deaths, or severe reactions, and immediately one blames the particular preparation which is being used. The fact that we have had no deaths with any of these salvarsans we attribute to chance. We have seen and been informed of deaths which other people have had and for which we have not been able to establish any reason in comparing the circumstances with our own practices.

From time to time we have purposely used batches of salvarsan which have given severe reactions either in our own hands or in those of other people, and always we have failed to again obtain the reactions. From our experience we are therefore forced to conclude that, aside from the matter of color and the time consumed in dissolving them, there are no practical differences in the various salvarsans as observed clinically.

THE WASSERMANN REACTION (Newcomer). It is desirable, perhaps, at this point to consider briefly relationships between Wassermann reactions and syphilis. We have published elsewhere some considerations of this sort.³ There are brought together in Table IV some interesting relationships which occasionally occur and which it is well perhaps to emphasize. The table is designed to show the way in which the Wassermann reaction may vary from time to time in the same individual, being now strongly positive, now weakly positive, now negative, and this in patients in which the clinical diagnosis of syphilis is quite certain. The table shows how little reliance can be placed upon a single Wassermann as far as indicating the patient's condition is concerned. It should also be emphasized that while the Wassermann reaction frequently becomes weak before it becomes negative it is certain that, as a general rule, the strength of the reaction bears no relation to the course of the disease. One cannot infer from a single weakly positive or even

³ P. A. Lewis and H. S. Newcomer: Jour. Exper. Med., 1919, vol. xxix, p. 351.

negative Wassermann reaction that there is any permanent change in the reaction. We might properly say here that in patients with syphilis it is usually the case that the cholestrolized antigen gives more positives than any other Wassermann system, and it is safer to use it than other Wassermann systems as a guide in the treatment of syphilis.

On the contrary, in the diagnosis of syphilis cholestrolized antigen may be too sensitive and may give weakly positive and sometimes strongly positive reactions with normal individuals. We have been in the habit up until recently of regarding a strongly positive Wassermann reaction with cholestrolized antigen as a sufficient evidence of syphilis. There is brought together in Table V a set of individuals having such strongly positive reactions who were so inducted into our salvarsan clinic. A more careful examination of their history fails to give any positive evidence of syphilis—in fact, is suspiciously negative in that regard—and these individuals can probably be legitimately regarded as non-syphilitic. The table shows to what an extent mistakes of this sort can be made.

There is a further aspect of the Wassermann question which must be considered. It is conceivable that those people who have had a great deal of salvarsan treatment paralleled with and immediately followed by positive Wassermann reactions may eventually become negative without further treatment. If that be so our results may not be so poor as they seem. It is probably not so. There is a very large question as to just what significance should be attached to a variable Wassermann reaction following a long course of treatment. We have had patients long negative who have subsequently at times shown positive Wassermans in a negative series. Salvarsan has been given but perhaps it was not necessary. It is, however, probable that people who have had a great deal of salvarsan are better protected against later serious lesions than those who have not had such treatment. As previously mentioned, it is also undoubtedly true that those who get a small amount of salvarsan often relapse, and may relapse early. Our results support the view that treatment in the early stages of the disease should be the most vigorous possible. Just what course should be followed later is still problematical.

The patient under any circumstances must look forward to a very tedious course of treatment. He has one of two alternatives: He may take treatment, half a dozen doses or so, sufficient to heal his present lesion, and then wait for a recurrence. This may or may not come. If it comes early he can take more treatment and go through the same thing again. It may come late and be a serious central nervous system lesion. He may, on the other hand, take a very strenuous course of treatment of one type or another over a period of several years and then, as a result of the history of many decades of past experience in the treatment of the disease, he can

count with some certainty on having no further trouble. How much these years of treatment may be lessened by the modern method of treatment with salvarsan would seem to be somewhat a matter of conjecture.

Economic Results. There is another side of the salvarsan story which alone compensates for a clinic such as we have, that is, an economic saving to the individual and to the community. When we think of the Pennsylvania Hospital for the Insane and consider that 15 per cent. of its patients are syphilitic, that its cost on this account amounts to a large sum, and that this by no means accounts for any considerable portion of the indigent syphilitic patients of the city, we can conjecture how much the nation may be paying out to support these people. If we could add the time as efficient wage-earners which is lost by being incapacitated the economic loss to the community would be large indeed. This is most concretely expressed perhaps by showing what systematic treatment may effect in a monetary way to the individual. A table has been prepared which picks out specifically twelve patients whose earning capacities are given, whose immediate loss of time due to the incapacitation in consequence of the disease and the cost of whose treatment and the time and amount of money saved through the agency of the salvarsan clinic is also given. It will be seen that for these twelve patients treatment costing them \$81 saved them \$1080 earning capacity and a year of time. If the clinic were a charity, which at present it is not, a charity so expended as to bring in 1000 per cent. on investment would be a very profitable one indeed.

Financial Statement. Our gross income based on an average attendance of 75 patients a week is approximately \$10,000 a year. Our expenses may be tabulated as follows, also approximately:

Salvarsan	\$4200
Physician	600
Social service worker	900
Nurse (one day a week)	250
Laboratory service (one day a week)	100
Miscellaneous supplies	600
Social service expenses	200
Drugs	300
	<hr/>
	\$7150 .

SUMMARY (Lewis). Our experience as presented in the preceding sections shows that it is practicable for any well-organized general hospital to establish a clinic for the treatment of syphilis without great expense to the institution and to the certain advantage of the community it serves. The fundamental questions of morality which underlie the spread of this infection do not properly present themselves for the consideration of the physician and the hospital in connection with such a clinic. The practice of segregating the syphilis clinic from the more general work of the hospital, which has

been so general, should be abandoned, as it makes the treatment appear to the patient in the light of punishment and to the hospital staff and management as a disagreeable duty. The interests of all are thus sacrificed to sentiment, and in the confusion the propaganda for better morals is not effectively advanced.

Medically speaking, our results confirm the prevailing view that once syphilis has invaded the body it is very difficult if not impossible to eradicate. Systematic treatment is, however, capable of minimizing its effects for the individual, and at the same time rendering him almost innocuous to the community. Such a clinic as this is probably more successful in securing treatment in this systematic way than is management by the private practitioner.

It being assumed that such clinical facilities as those described have been made available in adequate amount, the attack on syphilis as a community problem should involve as a measure of the first importance systematic effort to secure treatment at the earliest possible moment for those infected.

THE CARDIOVASCULAR DEFECTIVE.

BY LOUIS M. WARFIELD, A.B., M.D.,

MILWAUKEE, WISCONSIN,

PROFESSOR OF CLINICAL MEDICINE, MARQUETTE UNIVERSITY SCHOOL OF MEDICINE;
RECENTLY MAJOR AND CHIEF OF MEDICAL SERVICE, BASE HOSPITAL,
JEFFERSON BARRACKS, MISSOURI.

WHEN material is plentiful it is not an unusual experience to discover new diseases or new symptoms or new relationships between diseases and symptoms. Impressions and facts found and seen in isolated cases which do not seem striking, assume added importance when seen time after time over a brief period in numbers of cases.

To most physicians the opportunity of observing thousands of the young manhood of this country, both well and ill, has come as a wonderful experience. Out of it has developed a great number of most valuable observations, many of which are of use in the civilian practice of medicine, surgery and allied branches. We have had to change certain of our ideas. Other ideas we have been able to establish on a firm basis, and still other ideas have been developed as we have gained in experience.

It was not unknown before the late war that there was a group of young men who suffered from inability to adjust themselves to their environment. Such cases were, for the most part, seen by neurologists who classified them among the psychoneuroses. Some cases who complained more particularly of their hearts fell into the hands of the general practitioners or the heart specialists. The number of

such cases was not great and the lack of any somatic lesion caused physicians to relegate them into the motley group composing neurasthenia. For the most of us to call a group of symptoms neurasthenia was an admission of diagnostic limitations. We felt that because so many loosely termed neurasthenics were found on careful study to have definite pathological lesions which could account for their nervous instability, all cases of neurasthenia should show some pathological basis. We very probably erred in swinging the pendulum too far on the physical side and neglecting too much the purely mental reaction of the patient.

The great variability of persons in their emotional spheres and in their subconscious reactions to varieties of stimuli certainly were not appreciated by the great majority of the profession. The inhibitory effects of training at home and in school were little considered. Inheritance, although stressed by many recent writers, did not have the place that it deserves in our summation of the factors which make a diagnosis. It was not that all these terms were not known and comprehended; it was that their full significance was neither fully understood nor fully appreciated.

The syndrome which is found in the cases called here cardiovascular defective has only received attention since the war began. This term is used in this paper synonymously with effort syndrome, irritable heart or neurocirculatory asthenia. Lewis and his associates first directed attention to this syndrome in soldiers who were invalided from the war fronts with the diagnosis, "Disordered Action of the Heart" (D. A. H.). Since his work cases having a similar group of symptoms brought out on exercise have been found not infrequently in civil life in men coming up for examination for military service. It is this latter class of men which form the material for this paper.

Certain characteristic symptoms are found in all cases of the cardiovascular defective. These are symptoms from which many men suffer when put through violent exertion. The differentiation between the defectives and the normal men is largely one of degree. Exercise of the lightest character serves to bring out in the defectives an exaggeration of all the symptoms of exhaustion. Typically after slight exertion the men become breathless, giddy, have pain over the precordium, palpitation of the heart and have a feeling of utter exhaustion. Frequently they have headache, are sleepless, rest at night really does not rest them and they have clammy, cyanosed hands and feet. They sweat profusely in the axillæ and have a mottled skin and unstable vasomotor reaction.

This train of symptoms follows practically every serious illness and lasts for a long or short time, depending upon the recuperative powers of the person affected and upon the severity of the illness. This is to be expected and causes no anxiety. It is only when the time has passed that recovery should be perfect and symptoms still

persist that permanent damage to the cardiovascular system may be suspected.

These men are not really ill. They have come before the examining officers at recruit depots as volunteers and as drafted men and have been passed by their local and advisory board examiners as normal men, although the increased frequency of the pulse-rate has been noted. This rapid heart action has been attributed to slight nervousness during examination rather than to any inherent defect in the man. Frequently such men do not have a pulse-rate over 100 to the minute and according to instructions in the *Manual* (Form 75, P. M. G. O.) have been passed without further questioning. The enormous amount of work which local boards were called upon to perform and the poor facilities often present for careful examination have been fruitful causes in the induction of such men into general military service.

During the first draft many of these men were passed by the army surgeons and sent to training camps, where their defect was early discovered during training, and they were brought before special boards and were given their discharge. Such apparently healthy men who could not perform the duties of a soldier were the bane of the cardiovascular boards at all the training camps. The knowledge that such a condition could exist in an apparently robust man was at first viewed with some skepticism and many men were thought, most unjustly as we now know, to be "slackers." Gradually it was borne in upon the army examiners that the defect was a real one and that these men were really physically unable to stand any violent exercise. The thorough appreciation of this condition never became universal, so that during the second and succeeding calls for men there were many of these defectives sent to camp.

With us at Jefferson Barracks, Missouri, an attempt was made to cull out these defectives before they were taken into the service. We were not wholly successful in that certain men who were examined before we fully appreciated the condition and who apparently were normal, later were admitted to hospital with the characteristic symptoms. These men had developed the symptoms under the setting-up exercises and comparatively light military duty given them at this post. Certain men, thought by us to be border-line cases, given the benefit of the doubt and accepted, also later were admitted to the hospital. Under such conditions it seemed to us most important to determine, if possible, the exact status of these defectives before finally disposing of them at the examining barracks. Consent was obtained from the surgeon, Lieut.-Col. C. E. Freeman, to place all suspected cases in a hospital ward and tents near the hospital, so that these men might be observed over a sufficient period to enable us to pass upon them intelligently.

To this end the cardiac examiners in the examining barracks were requested to refer all cases of increased pulse-rate to a special

examiner, in the same building, for his opinion. There was plenty of time to examine carefully, in a quiet room, all referred cases. The method used in examining the hearts of the recruits and drafted men lent itself well to the selection of the tachycardias. The men hopped a distance of about 80 feet, half the distance on the right foot and half on the left. They lined up in sections of fourteen in a room where two medical officers were, one who examined the heart and the other who examined the lungs. By the time the group had been examined enough time had elapsed for the normal heart to return to normal rate. The exercise was enough to continue acceleration of the pulse-rate in the defectives over a period of several minutes. Tachycardia under such circumstances was considered to be of sufficient significance to demand further and more careful examination.

Tachycardia is known to be produced by a variety of conditions. Hence, at the final examination in the barracks by the two members of the special board, the tuberculosis and cardiovascular examiners, cases were sorted into several categories. Some were frankly tuberculosis and were at once rejected. Some were cases of exophthalmic goitre, of definite hyperthyroidism, of cirrhosis of the liver, chronic malaria with enlarged spleen, bronchial asthma, etc., and were at once rejected. There were, however, others which could not be so summarily dealt with. These were cases in which tachycardia or a very labile pulse was found and in whom no definite lesion of any kind could be discovered. These men were sent to the hospital for further observation and examination. A uniform history was obtained from every man according to the subjoined history form:

HISTORY FORM.

Family History:

1. Father or mother alcoholic? Ans.
2. Father or mother nervous? Ans.
3. Father or mother insane? Ans.
4. Father or mother tuberculous? Ans.

Past History:

1. How long have you worked? Ans.
2. Just what do you do? Ans.

Sedentary	Light	Moderate	Heavy
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3. Have you had to quit a job because too hard? When?
4. Ever become dizzy or faint at work? At play? When?
5. Are you short of breath on exertion? Ans.
6. Ever had pain over your heart? When?
7. Ever had palpitation of the heart? Ans.
8. Do you sweat or flush easily? Ans.
9. Are you subject to headaches? What part of your head?
10. Are you nervous, easily excited?
11. What fevers have you had? When each one?
12. When did you *first* notice any trouble? Ans.

After careful examination the men were placed in squads and daily exercised with mild setting-up exercises under the charge of a non-commissioned officer who had been schooled in the drill. The exercises recommended by Lewis were used. His C¹⁵ and D³⁰ were given, supplemented by hikes of varying distances and periods of double-quick. Temperature readings and pulse-rates were taken on all patients every three hours. Exercise was so timed that the 3 P.M. readings were taken from twenty minutes to half an hour after exercise. In this manner we studied over 400 referred from the heart and lung room in the examining barracks. Many of these proved to be simple excitement tachycardia and no record was kept of them.

We studied carefully 315 cases and exercised 158 in the hospital. In 297 the records were complete enough for later use.

DISPOSITION OF CASES AT EXAMINING BARRACKS.

- 60 cases (37.0 per cent.) diagnosed hyperthyroidism, rejected.
- 47 cases (29.0 per cent.) diagnosed pulmonary tuberculosis, rejected.
- 52 cases (32.0 per cent.) diagnosed irritable heart, rejected.
- 2 cases (1.2 per cent.) diagnosed cirrhosis of the liver, rejected.
- 1 case (0.8 per cent.) diagnosed bronchial asthma, rejected.

DISPOSITION OF CASES OBSERVED IN HOSPITAL.

- 40 cases (29.6 per cent.) no lesion found, normal, accepted.
- 17 cases (12.6 per cent.) diagnosed hyperthyroidism, rejected.
- 47 cases (34.8 per cent.) diagnosed pulmonary tuberculosis, rejected.

- 29 cases (21.5 per cent.) diagnosed irritable heart, rejected.
- 2 cases (1.5 per cent.) diagnosed cirrhosis of the liver, rejected.

It will be seen that cases of pulmonary tuberculosis and hyperthyroidism (including exophthalmic goitre) composed the greater proportion of the two groups. As a matter of fact the symptoms complained of by men are so similar in the cases of the diseases named above and irritable heart that it is only after the most careful study that the cases can be separated into the proper group.

Our cases of irritable heart, the cardiovascular defective, fall into three groups:

A. Strictly cardiovascular.

1. Following infectious disease. Chronic myocardial degeneration.
2. Existing since childhood.
 - (a) Associated with poor mentality.
 - (b) Associated with good mentality.

B. Some defect in endocrine secretion.

1. Hyperthyroidism.
2. Exophthalmic goitre.

C. Associated with definite somatic lesions.

1. Pulmonary tuberculosis.
2. (Hodgkin's disease).
3. Focal infectious: chronic.
4. Other diseases: cirrhosis of the liver (hookworm), asthma, etc.

A. The following case is typical of the first group, subsection 1:

CASE 21, A. W. S., recruit, aged twenty-seven years, a farmer. His father died of cancer of the stomach. His mother is living, but is nervous. She has heart trouble and rheumatism. He has three half-brothers, one half-sister, children of the same father. All are well. His mother was thirty-four years old when he was born. He went through the country school but did not pass in all branches. Can read, write, spell and compute fractions. He left school at the age of sixteen and has worked on a farm since. Has worked hard, and up to five years ago had never been ill. At that time he had rheumatism, evidently articular, which lasted for three months. He has never since that time been able to work hard. About one year ago he had "heat stroke." Since then he tired even more easily, has palpitation of the heart, gets dizzy and short of breath on slight exertion. The patient is tall, a healthy looking and well-muscled man. Pulse sitting 94, very labile. Hops ninety times on one foot and then is exhausted, dizzy. Pulse is 142, regular. He is breathless, has no pain. Two minutes later, pulse 112. The apex-beat is in the fifth interspace 7.5 cm. from the midsternal line. Heart sounds are clear. The pulmonary second is accentuated. Diagnosis: Irritable heart, caused by acute articular rheumatism resulting in myocardial weakness.

This case seems to have followed a severe attack of articular rheumatism, although the sunstroke was claimed to have made the man more easily exhausted. We have had several such cases. All occurred in farmer boys and all dated their symptoms from the sunstroke. If sunstroke, as claimed by some, is an infection, then the cases of effort syndrome following this cause must be classed as myocardial in character.

CASE 10.—A more typical case is that of P. B., recruit, aged twenty-five years, single, an automobile machinist. The family history is negative. He was never really ill until four years ago. He went through the eighth grade in school, then took a course in an automobile school. Four years ago he had a severe attack of typhoid fever. Since recovery he has been exhausted easily, had precordial pain and breathlessness on slight exertion. He is not ill or incapacitated for his work, which is light. He is a well-muscled man. Pulse standing, 136; heart sounds are loud, with a short systolic murmur at the apex. Apex-beat is found in the fourth interspace, 8 cm. from

midsternal line. He hops one hundred times without great difficulty. The heart pounds 176 times to the minute; there is breathlessness and some dizziness. After three minutes rate is 148; breathlessness still present. Apex of heart definitely moved to left, showing dilatation on exercise. Diagnosis: Irritable heart, effort syndrome.

Cases belonging to the second subgroup of the first Group A are those which come strictly under the heading of cardiovascular defectives. In them no cause whatever can be discovered. They represent a class which has had a bad start in life. Tracing the family history reveals nervous instability on the part of one or both parents, alcoholism or insanity. Often the mother is beyond the age of thirty when the boy was born. So many come from the farmer class that it would appear to be some environmental factor either affecting parents or child, or both, which produces tissues poor in resistance. These boys lack ambition. They do not think much about affairs in general. The work they do is desultory. Whenever they feel tired they stop for a while and rest. Such cases have had little schooling. Some appear stupid from lack of opportunity, but the stupidity for the most part is that of mentality of a low order, and apparent undevelopment of the brain. Such a case is the following:

CASE 9.—H. C., recruit, aged twenty-one years, a farmer, has a family history negative as to nervousness or any insanity. He had very little schooling, the history showing that he was not particularly bright. In the hospital here he appeared so subnormal mentally that he was sent to the psychiatry staff for examination. Nothing definite was found except slow cerebration. His complaint dating back several years was of breathlessness on exertion and exhaustion and pain over the heart. He was also nervous and unable to sleep at night. He stood the graded exercises poorly. He never drilled since entering the army February 25, 1918. Physical examination negative except for rapid heart. Apex-beat within nipple line. Cannot hop one hundred times. Pulse before exercise, 108; after exercise, 160. In two minutes still rapid, 130. Dizziness, exhaustion and breathlessness complained of. Diagnosis: Irritable heart. Recommended for surgeon's certificate of disability.

The other class of case in this subgroup exhibits the same symptoms physically, but the mentality is above the average. It is no lack of opportunity for education in such cases illustrated above, but a real lack of ability to learn. This actually has no particular bearing upon the train of symptoms exhibited by these men. It only serves to group them into the two classes, in either one of which the same syndrome is brought out on slight exertion. The man with subnormal mentality necessarily never gets beyond a certain low scale in community life. His capabilities are necessarily so limited and his physical disability is so great that he has not the will to overcome his physical defects and force his brain to act. In

the struggle for existence he can just keep himself above water. The other class finds better living conditions, better pay provided he can obtain a position which supports him without the necessity of physical exertion. Such a case is the following:

CASE 26.—L. C. B., recruit, aged twenty-five years, is a clerk by occupation. His father has had nervous headaches for years and his mother's health is only fairly good. He was sick in bed for the greater part of his childhood because of nervousness and missed a large part of his schooling. He had no difficulty in learning when he was in school. Five years ago, while at a show, he became unconscious and remained in a stupor for three days. It was said to be nervous prostration. He has always suffered from headaches and has never been able to exercise on account of exhaustion, breathlessness and headaches. He has been able to keep a position as city clerk, where the work is very light and not very steady. He is not able to work every day. On examination he appears to be a robust young man. Lungs, heart and abdomen show no abnormalities. Slight apical cardiorespiratory murmur is present. Sitting quietly, pulse 100. After hopping exercise, pulse 160. There were breathlessness, sweating hands, precordial pain, exhaustion, dizziness. Two minutes later pulse still fast, 130. Blood-pressure normal. Diagnosis: Irritable heart.

The second group containing the subheadings hyperthyroidism and exophthalmic goitre is too well known to need extended comment. The symptoms complained of by these men differ only in degree from those presented by the men with irritable heart. The important point to bear in mind is that these cases besides having tachycardia have also tremor of the extended fingers, lagging of the upper lids when looking quickly down and often poor convergence at near vision. Besides, as we have shown elsewhere, the blood-pressure in these cases is usually raised, whereas the blood-pressure in the cases of irritable heart is normal or inclined to be slightly below normal. The blood-pressure is raised in the hyperthyroidism-exophthalmic goitre group, and normal or below normal in the strictly irritable heart group. Diagnosis between these groups is not always easy nor is it always possible. One competent examiner will classify a case as one of irritable heart, an equally competent examiner will classify the same case as hyperthyroidism. The distinction appears to the writer to be valuable only in so far as the latter is a potential acute exophthalmic goitre. I do not believe there is any emotional shock violent enough to bring out Graves's disease in a normal man.

There is one difference which we discovered between the cases of true irritable heart (effort syndrome) and the cases of hyperthyroidism. That was the response to graded exercise. The former responded poorly. The latter were usually able to perform the setting-up exercises up to D,³⁰ with no subjective symptoms. The

tachycardia was often the only sign of abnormal reaction. Occasionally the tremor of the hands was increased.

In this group we may suppose some abnormality of the internal gland secretion. The relationship between the adrenal and thyroid glands appears to be a close one. We have proof that in states of anger, fear or other great emotion the adrenal secretion is suddenly greatly increased. The thyroid gland is powerfully stimulated to activity and metabolism is increased. This necessitates more rapid blood circulation and consequently more rapid heart action. It has been shown that the metabolism of patients with Graves's disease is greater than that of individuals of similar size, age and weight. The hyperthyroidism cases are after all only mild forms of Graves's disease. Some even call them Graves's disease, preferring not to use the term hyperthyroidism, which connotes increased thyroid secretion. As a matter of fact it is not universally admitted that hypersecretion of the gland takes place. There can be no doubt that the condition is a result of some aberrant functioning of the gland, whether alone or in response to some stimulation from some other gland of internal secretion. Until further light is thrown on the subject we shall have to content ourselves with hypotheses and speculation.

Group C. In this group are placed a number of diseases which cause, in the victims, symptoms so like the effort syndrome that only the most painstaking observation and examination will serve to make a correct diagnosis. Foremost among this group of diseases is pulmonary tuberculosis in the incipient stage. When patients have largely symptoms of the absorption of tuberculotoxin without very definite physical findings, the problem of diagnosis is a difficult one. Our cases were always examined by at least two men, and they were examined often when any doubt existed. The men were sent to the hospital because of persistent tachycardia, that being the objective finding which was most evident. They were placed in the group of cases under observation. The temperature, pulse and respiration were taken every three hours and they were exercised by the drill instructor. By this means we were able to sort out the cases of tuberculosis from the other cases with tachycardia by observing the rise in temperature following exercise and the development or increase of physical signs. The following case illustrates this point:

CASE 15.—L. L., recruit, aged twenty-two years, complained of loss of weight and exhaustion on slight exercise, with some dizziness and precordial pain. He had gradually developed these symptoms within six months. His family history was negative and his past history revealed no serious illnesses. He had always been healthy and able to work. On examination there were slight signs of infiltration at the left apex. Rales were variable. Roentgen-ray plates showed slight haziness at the left apex. There was no cough and

no sputum. Even the slightest exercise caused him great distress and the temperature taken from twenty to thirty minutes after the exercise always showed a rise. The morning temperature was sub-normal. Frequent examinations, the rise of temperature following exercise and his exceedingly poor response to exercise led us to the diagnosis of incipient pulmonary tuberculosis. His exercise response was far more severe than any of the cases of irritable heart.

I feel sure that hookworm disease and early Hodgkin's disease would show the same effort syndrome. I have no case histories to prove my contention. I have only recollection of symptoms complained of in patients seen in civilian practice. Uncinariasis is easily diagnosed. Early Hodgkin's disease is not so easily detected.

Chronic focal infections also may show typical effort syndrome. I have observed no cases in my studies, but I agree with those who make this assertion. I have not seen the removal of tonsils or the opening of nasal sinuses or the cleaning of apical tooth abscesses cure cases which had the effort syndrome, although I have no doubt that such cases do occur and such pathological conditions should always be kept in mind so that gross errors in diagnosis are avoided. I have seen bronchial asthma, cirrhosis of the liver and chronic malaria in patients who had effort syndrome and tachycardia. These patients were much improved under treatment. Those with the last-named disease went back to duty.

ETIOLOGY. We do not know why certain healthy, even robust-looking men have this strange inability to respond as normal persons do to a slight amount of physical exertion. They are always in the condition of a normal man just convalescing from a severe illness. No wonder that they lack ambition to overcome obstacles and are passed in the race of life. In the history of the cardiovascular defective certain points may be emphasized. The first is the parental history. These men do not have a fair start. One or both parents suffered from nervousness, chronic headaches, insanity or were alcoholic in 52.5 per cent. of the cases. Practically all the men dated their symptoms into childhood. "As long as I can remember" was a frequent response to the question, "How long have you had these symptoms?" In only 50 per cent. of my cases was there a definite time set, which followed some infectious disease. The other 50 per cent. could set no time of onset nor could they say that infectious disease had any relation to the symptoms. The fact that so many of these defectives come from a neurotic parentage and are brought up in an environment surcharged with bodily complaints renders them introspective of their small ailments. Eventually their mental states so dominate the somatic functions that trivial sensations are magnified to an extent which causes them acute suffering. Should this take the form of palpitation of the heart, sensible to them, and should some doctor tell them they have heart

disease and treat them for it, the cases become practically helpless hypochondriacs. The following is illustrative of this group:

CASE 30.—F. C. J., recruit aged twenty-five years, was a big, healthy looking fellow, but always had a worried look. He entered the army at this post July 11, 1918, admitted to the hospital July 16. His mother was neurotic, a fussy woman; his father was well. Several brothers and sisters were all well. As a child his mother said he was always nervous—never could play with the other children, as he became easily exhausted. He was evidently nagged during his youth. When he was old enough to work he was taken away from one position after another as soon as he made any complaint. Finally, about four years ago, his mother took him to a doctor who told him he had serious heart disease and treated him for it up to the time he was drafted into the army. He was married and was supported by his wife and mother. He could not do any work. He complained of inability to perform even the slightest exercise. He was obsessed with the idea that he had serious heart trouble, his mother and wife abetting him in this belief. On slight exertion his heart pounded, he had precordial pain, dizziness, headache, breathlessness and exhaustion. On physical examination he was tall, well built and a strong looking man. The pulse was always rapid. The heart was slightly enlarged. There was a soft, short systolic murmur at the apex not considered to be organic. The lungs were negative. The blood-pressure was 116-80. Exercise response was poor. There were rapid pulse, pounding heart and anxious expression. The vasomotor instability was marked. Diagnosis: Irritable heart, hypochondriasis.

Frequently in the histories of these cardiovascular defectives there will be fainting spells, attacks of dizziness when everything gets black, or there will be convulsive seizures and unconscious periods lasting for hours or days. Attacks of nervous prostration in children are not uncommon. Such abnormal conditions can only occur on a marked neuropathic basis. The cases which date their symptoms from some infectious disease have not given such histories. They complain only of the symptoms which follow exertion and which they are certain were not present previous to the illness. In these cases one may feel reasonably sure that the myocardium has been permanently damaged. Dilatation of the heart following slight exertion will account for all the symptoms of the effort syndrome.

When no cause can be assigned we are forced back upon the term "constitutional inferiority," which explains nothing. It simply states a fact with which all are familiar.

GRADED EXERCISE. Graded setting-up exercises were begun, with the idea of hardening the men so that they could do full duty. It was thought that a certain number of men with the effort syndrome could be gradually strengthened. Before the cases were fully recognized at the examining barracks some men were accepted

who had mild symptoms, with slight tachycardia at rest. These men were put out at the usual setting-up exercises. Some fainted, some grew so dizzy that they had to be excused, some managed to get through a day's exercise, but were exhausted and bed-ridden for the next day or two. Hence it was felt that a more gradual break-away from their sedentary civilian lives would render these men less liable to break down under violent exercise. In this we were disappointed. In no case of true effort syndrome was there any betterment even after days of the slightest exercise. Any attempt to go from very light to a light exercise brought on symptoms more violent than before. On the other hand, there were cases diagnosed irritable heart at the examining barracks who were accepted for limited service. Two months later at the examination for demobilization many of these men had normal cardiovascular response to exercise. In every case in which the condition had apparently cleared there were absolutely no symptoms complained of at any time in the man's life except the pounding of the heart following violent exertion in men who were unaccustomed to exercise. They were clerks or others who led sedentary lives. On the contrary, the cases which still revealed the effort syndrome were those who had complained of precordial pain or dizziness with the pounding heart after exercise and previous to their induction into service. These men without exception stated that they had not been able to stand the light drill and had been working the past two months as clerks. This lends weight to the point that in the history of the man there must be one or more of the cardinal symptoms of the syndrome. The tachycardia alone is not sufficient for diagnosis. The pulse may remain rapid longer than two minutes after the usual test exercise of hopping one hundred times on one foot. There may even be great exhaustion present, but if there have been no symptoms which careful inquiry has elicited, one is not justified in diagnosing the case irritable heart.

The temperature of every patient was taken twenty minutes after exercise. The cases of pulmonary tuberculosis could be picked out by the temperature reaction. All the men exercised were those upon whom a definite diagnosis had not been made. It was found that cases could be sorted into groups according to their response to exercise. For example, the cases of suspected hyperthyroidism responded best to exercise. The pulse-rate was not so high, there was no rise of temperature and symptoms were not so severe, as a rule. Further, they often were able to increase exercise without discomfort. The cases of effort syndrome showed no improvement under exercise. They often grew worse and had to be excused. The temperature was not raised in these men. The cases of suspected pulmonary tuberculosis usually responded badly to exercise. They became easily exhausted, and showed marked breathlessness. The temperature was always raised from 1° to 3° after exercise, and there

were frequently rales heard over one or both apices where none had been heard before. Graded exercise, therefore, is not only of therapeutic value, but it becomes of real diagnostic value under certain circumstances. Further, in the cases of effort syndrome when the symptoms dated definitely from some serious illness, often ten to fifteen years previously, there was frequently demonstrable an actual displacement of the apex-beat to the left following the exercise. This could have but one meaning and hence was interpreted as dilatation of the left side of the heart.

PROGNOSIS. As has been stated, it has not been possible for us to benefit these cases by graded exercise. After some experience with the cardiovascular defectives we rejected them after studying them in hospital in order to be sure we were making no mistakes in diagnosis. Those with marked psychoneurotic state we consider to be hopeless "spongers" on their families or on the communities in which they live. Other cases who have been making a living at farming or clerking we see no reason to predict any bad fate for. As long as they recognize their limitations and live always within them they should have no difficulty in keeping well and free from distressing symptoms, chiefly palpitation and precordial pain.

SUMMARY. There is a class of young men of usually healthy appearance who nevertheless suffer from a group of symptoms following mild exercise characterized by breathlessness, precordial pain, dizziness, palpitation and exhaustion. There also may be headache, sleeplessness, cold, clammy hands and feet and profuse sweating. These men might never have been discovered except for the army draft, which caused thousands of young men to be examined physically. These men have no complaints, as a rule, which lead them to seek medical advice. They find that they are better able to make a living at light or sedentary work than at hard work, so they drift into the lighter occupations. The majority are surprised when told that there is something really the matter with them, although they have recognized the fact that they cannot take the violent exercise which other men of their acquaintance can take. A certain number are taken by their parents to a doctor, who may diagnose heart disease or neurasthenia.

There is no common etiological factor among the true cardiovascular defectives—no cause can be found except a constitutional inferiority, a poor quality of tissue which must be supposed to account for the syndrome. Among others, certain chronic diseases or the result of severe acute illnesses are responsible for the syndrome.

When there is a definite pathological basis, such as pulmonary tuberculosis or chronic focal infection, etc., cure of the disease causes the effort syndrome to disappear. Cases resulting from infectious disease or based upon constitutional inferiority do not improve in our experience.

Exercise was valuable in determining the fitness of the men for

military duty and in giving data in the diagnosis of certain cases suspected of being tuberculosis. The cases were studied primarily for the purpose of sorting the fit from the unfit in military service. Happily, no longer this must be done. However, the knowledge gained in observing these cases is not devoid of value to us in civil life. It should materially assist us in handling a group of cases hitherto poorly classified and insufficiently studied.

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A CASE OF PERFORATED GASTRIC ULCER, WITH ABSCESS FORMATION; PERFORATION THROUGH THE LUNG, WITH SPONTANEOUS RECOVERY.¹

BY JULIUS FRIEDENWALD, M.D.,

PROFESSOR OF GASTRO-ENTEROLOGY, UNIVERSITY OF MARYLAND SCHOOL OF MEDICINE
AND COLLEGE OF PHYSICIANS AND SURGEONS, BALTIMORE, MARYLAND.

CASES of perforation of the stomach and duodenum leading to subphrenic abscess, with rupture through the lung, are of sufficient rarity to be of interest. The patient, Mr. W. P. G. aged fifty-one years, was first seen in consultation with Dr. O. N. Duvall on April 5, 1917. His family and personal histories were entirely negative and unimportant, except as related to his gastro-intestinal tract.

The patient had complained of gastric disturbance for the past twenty-five to thirty years. During this period there was frequent indigestion, consisting mainly of fulness after meals and belching. For the past eight to ten years the attacks of indigestion were periodic, lasting for three or four weeks to several months at a time. These attacks were characterized by pain in the stomach appearing two hours after meals, more marked after solid food, which were

¹ Read at the meeting of the Association of American Physicians, Atlantic City, June 17, 1919.

relieved by the use of soda or by rest in the recumbent posture. There were eructations of acid matter, and pyrosis was frequent. Hunger pains were often present, which were relieved by food, the pain recurring two or three hours later. There were periods of six months or more, during which the patient enjoyed perfect health, free from all digestive symptoms. He was always constipated; was frequently nauseated; vomited at times; however, he had at no time vomited blood or food eaten the day previously, nor had he passed tar-colored stools. The appetite was good; there was no history of jaundice. The patient complained of hemorrhoids. He had had lumbago and was affected with nocturia, micturating once during the night; there was no history of swelling of the feet or eyelids; no dizziness. The patient denied having had lues or gonorrhea.

Present Illness. After some weeks of indigestion, of such a character as has already been described, the patient was suddenly seized with severe agonizing pains over the left upper abdomen, which required the administration of two hypodermic injections of morphin for relief. At that time the abdomen was distended and there was present a distinctly tender epigastric area. The following day he developed dull pain in the left kidney region, which radiated toward the epigastrium. This pain persisted for ten days and was accompanied by a temperature ranging between 101° to 103° . He developed a cough and hiccoughing, which were shortly followed by a purulent expectoration; he expectorated during the first day about one quart of pus. When the expectoration began the temperature receded and the pain became greatly diminished. At this stage the patient was admitted into the Union Protestant Infirmary (April 6, 1917).

Examination. The patient is a thin, poorly nourished individual, with much respiratory discomfort and a facial expression of distress. The skin and mucous membranes were pale; the ears and eyes were normal. The alæ nasi moved rapidly in respiration. The tongue was coated; there was a marked pyorrhea alveolaris.

Chest. The physical findings of the chest were negative, except that there was some impairment of the percussion note on the right side over the region of the scapula. However, on auscultation nothing abnormal could be discovered in this region. The heart was not enlarged; the sounds were clear; there were no murmurs.

Abdomen. The abdomen was somewhat distended. The recti muscles were spastic. There was a distinctly tender area in the epigastrium as well as tenderness in the left lumbar region, over which there was a burn caused by hot applications to that region. The liver extended one finger's breadth below the costal margin. No masses were felt anywhere. The genitals were normal; there were no glandular enlargements. The reflexes were present and were equal and active on both sides.

Blood examination: Total leukocyte count, 11,900. Differential count: Polynuclears, 70 per cent.; small mononuclears, 25 per cent.; large mononuclears, 4 per cent.

Urinary Examination. The urine had a specific gravity of 1022; presented a trace of albumin, but was otherwise negative.

Roentgen-ray Examination. Stomach: High stomach, rapid expulsion, defect at pyloroduodenal junction, revealing an ulcer at this area.

Chest: No emphysema or thickened pleura. Dilatation of bronchi at bases showed bronchiectasis. Cloudy infiltration below the right clavicle.

NOTE.—Since admission into the hospital the patient expectorated about one pint of pus the first day, the quantity decreasing each day since that time; finally, on April 11, he expectorated but 50 c.c. of pus, and on April 12 there was no further expectoration. The pus was thick and creamy and of a putrid odor, containing colon bacilli as well as streptococci in abundance.

On admission the patient's temperature was 100°, which gradually fell, so that after April 12 it remained normal. His appetite improved and he began to feel much stronger. He left the hospital on April 12 greatly improved in health, and has remained well since.

It is clear that the patient must have had a gastric ulcer, persisting over a long period of time. This became evident from the long ulcer history, with periods of remission, as well as from the definite roentgen-ray signs of ulcer, which were revealed at the time of his entrance into the hospital. The sudden onset of abdominal pain, requiring two hypodermic injections of morphin for relief, indicated the onset of the perforation, which was followed by fever, the formation of subphrenic abscess and finally a perforation through the lung, with the expectoration of pus. After the abscess was thoroughly evacuated the patient made a spontaneous recovery.

In an extensive monograph published in 1894 Maydl reports 179 cases of subphrenic abscesses, the stomach and duodenum being the source of infection in 35.

Subphrenic abscess may be either intraperitoneal or extraperitoneal, the latter being more frequent on the left side. Since the falciform ligament acts as a firm wall the abscesses are found usually on one side only. The right-sided ones are between the diaphragm and the liver. The left-sided ones have the diaphragm above and below, and for boundaries some part of the stomach, spleen, transverse colon and left lobe of the liver. The origin of the infection may arise from any one of these organs. The abscess appears as an encysted localized peritonitis and the cavity may be very small or large enough to hold several liters of pus or pus with gas. The pus may be thick or thin, putrid or free from odor, or colored with blood. The gas may arise from the opening to the

organs, which may contain gas or may be due to the gas bacillus of Welch.

In Maydl's series of 179 cases, of which 47 contained gas, 20 were due to perforation from the gastro-intestinal tract, 18 to secondary perforation (16 into the lung and 2 into the gastro-intestinal tract) and 9 to the gas bacillus, no perforation having been observed. The organisms most frequently observed in the pus are the tubercle bacillus, staphylococcus and the colon bacillus.

Osler notes that the presence of the colon bacillus in the pus indicates the gastro-intestinal tract as the origin of the infection. If the abscess is not disturbed it is liable to perforate the diaphragm infecting the pleural cavity and lung, and complete evacuation may take place through the lung; thus spontaneous cure might be effected, as was observed in our case.

In perforation of gastric ulcers producing subphrenic abscesses the symptoms may develop slowly, but, as a rule, the pus accumulates rapidly and the symptoms are usually exceedingly acute. There is often a sudden severe pain in the epigastrium or hypochondrium radiating to the shoulders, with marked dyspnea due to pressure on the diaphragm. There is usually present, in addition, vomiting, hiccough and marked weakness and acceleration of the pulse. Fever with chills and sweats are not uncommonly observed. Perforation of the diaphragm and rupture into and through the lung next occurs, with complete evacuation through a bronchus.

There are but four cases recorded similar to ours in which perforation from a gastric ulcer was followed by rupture through the lung.

CASE I.—Leyden.² The patient, aged seventy years, was suddenly taken with acute abdominal pain. There appeared to be some obstructive condition of the bowels, as it seemed impossible to produce a bowel evacuation; finally, after three days, the bowels moved, but fever then appeared, with chills and dulness on the right side of the chest up to the middle of the scapula. There was then a sudden expectoration of a large quantity of bloody fetid pus.

CASE II.—Juliusberge.³ A. B., aged forty-three years, was treated for rectal hemorrhages which had weakened the patient very materially. He also complained of digestive discomfort, loss of appetite; pressure and fulness in the region of the stomach, especially after meals; belching; pain and flatulency. The patient was suddenly taken with hematemesis and pain in the stomach and fainting. On examination the epigastrium was found markedly distended and a mass was formed in this region; chills and fever appeared; finally the patient expectorated a large quantity of pus.

² Ztschr. f. klin. Med., i, 320.

³ Berl. klin. Wchnschr., 1874, p. 643.

CASE III.—Neusser.⁴ A female patient, aged thirty-seven years, observed a swelling in the abdomen above the umbilicus. In addition there were numerous digestive symptoms, loss of appetite, green stools and pain after food. A cough appeared and was finally followed by the expectoration of pus. The patient died and at autopsy a perforated gastric ulcer was found, leading to a pus cavity in the lungs.

CASE IV.—Nowack.⁵ A maid, aged nineteen years, had frequently been affected with gastric disorder. She was suddenly seized with sharp pain in the lower abdomen. The pain increased and the abdomen became swollen. The patient began to vomit and became very weak. The pain in the region of the liver increased; the pulse became rapid and weak and the temperature subnormal. A perforation of the stomach was diagnosed and an operation performed. From one to two liters of fibrinous fluid were found in the abdominal cavity. The patient died and at autopsy an abscess of the lung was revealed, produced by the perforated gastric ulcer.

LUMBAR PUNCTURE AS A FACTOR IN THE CAUSATION OF MENINGITIS.

BY PAUL WEGEFORTH, M.D.,

CAPTAIN, U. S. A.,

AND

JOSEPH R. LATHAM, M.D.,

FIRST LIEUTENANT, U. S. A.

(From Base Hospital, Camp Jackson, S. C., and the Army Neurosurgical Laboratory, Johns Hopkins Medical School, Baltimore, Maryland.)

RECENT studies on experimental meningitis in the Army Neurosurgical Laboratory⁴² have demonstrated that the release of cerebrospinal fluid during certain artificial septicemias in animals is followed by a localization of the infection within the meninges. The method employed in these investigations consisted in giving an animal an intravenous injection of a suitable dose of an organism whose pathogenicity for the meninges was known to be high. Following this, spinal fluid was withdrawn during the height of the septicemia, either by lumbar or cistern puncture.⁴³ Animals subjected to this procedure invariably developed a fatal meningitis. Control animals inoculated intravenously with similar or larger doses of the same organisms, and not subjected to lumbar or cistern puncture, remained normal and showed subsequently no evidences

⁴ Wien. med. Wehnschr., 1884.

⁵ Schmidt's Jahrb., 1891, Nos. 9 and 10.

of involvement of the central nervous system. This led naturally to the question of the possible clinical importance of such observations. Opportunity for the clinical investigation of the problem was afforded by the Surgeon-General of the Army during the fall of 1918 at Camp Jackson, S. C., where, through the courtesy of Major M. A. Barber, chief of the laboratory, and Major W. W. Herrick, chief of the medical service at the base hospital, much valuable material was made available.

It is quite evident that in any clinical series it is necessary to take the septicemias as we find them. As was demonstrated in the paper mentioned above,⁴² upon the degree of intensity of the septicemia depends largely the probability of meningitis following lumbar or cistern puncture. For this reason it should not be expected that a clinical series will show the danger of such a procedure as conclusively as it was shown to exist in animals.

CLINICAL OBSERVATIONS. The objects of this field work were to ascertain the frequency with which cases of septicemia were subjected to lumbar puncture for diagnostic purposes, and also to learn, when the fluids resulting from such punctures were negative, what the final outcome of the case would be in respect to the appearance of meningitis. To accomplish this it was necessary to have blood cultures taken synchronously with the puncture or within a few hours of the time when it was performed, a procedure which was made quite simple by the coöperation of the bacteriologist of the laboratory, Lieut. E. B. Anderson. Examination of the spinal fluid was made immediately after its withdrawal, and consisted of the routine analysis in respect to character, cell count and differential, sugar and globulin content and cultural manifestations. A smear from a centrifugalized portion of the specimen was always made. The cultures were obtained from the centrifugalized portion also, in addition to which clear specimens were incubated separately. As soon as possible after the analysis the patient was examined in the ward and the subsequent clinical course observed at frequent intervals.

From September 25 until November 7, 1918, 93 patients were suspected of having meningitis and subjected to lumbar puncture. Of these a positive diagnosis of the disease was made in 38 instances from the spinal fluid obtained at the first puncture. The remaining 55 cases yielded clear fluids containing neither pus nor organisms, but among them there were 6 patients who, at the time of the primary puncture, had positive blood cultures. In 3 of these 6 the organism concerned was the meningococcus and in 3 the pneumococcus. Five of these patients subsequently developed meningitis, the one not contracting the disease being a case of pneumococcus septicemia, which eventually went on to recovery.

Pneumococcus Infections. Of the 4 cases of pneumococcus meningitis observed at the base hospital at Camp Jackson during

the period which this report covers, 2 developed the disease subsequent to withdrawal of clear normal fluid by lumbar puncture. The first of these patients, J. P., entered the hospital on September 30 with pneumonia. On October 5 his condition was noted as serious; three days later there was some stiffness of the neck, with tremor and unequal reflexes. His condition did not improve and on October 10 he was reported as being stuporous, with rapid respirations. Slight rigidity of the neck was present, but Kernig and Brudzinski were absent. A lumbar puncture was made, the spinal fluid obtained being clear and containing 3 cells per c.mm. Globulin was normal and sugar was present. Both smears and cultures of the fluid were negative. The opinion at the time was that the case was one of meningismus from toxemia of pneumonia, although the pressure of the spinal fluid was normal. On the day following this (October 11) there was a slight improvement in the patient's general condition, but a blood culture taken then demonstrated the presence of a Type IV pneumococcus. On October 12, the patient's condition remaining unchanged, a second lumbar puncture was performed. The fluid was again clear, contained 5 cells (no red blood cells) per c.mm., and was normal in all respects. Cultures were negative. Two days after this second puncture his condition became worse. He responded to questions intelligently, but had definite rigidity of the neck; Kernig and Brudzinski were marked and all reflexes were exaggerated. A third lumbar puncture at this time yielded a cloudy fluid containing 1200 white blood cells per c.mm. There was also a marked increase in globulin content, with absence of sugar. Both smear and culture showed the presence of the pneumococcus, which typed the same as that found previously in the blood. The patient died October 15 (the third day after the second puncture) and the autopsy showed a thick, purulent exudate over both hemispheres and with little reaction in the ventricles.

In this instance the patient was not only very toxic but also showed signs suggesting meningitis, so it is not surprising that a lumbar puncture was resorted to. In the following case, however, the clinical signs indicating such an exploration were absent and the relationship between the diagnostic puncture during a septicemia and a subsequent meningitis is clearly shown.

This soldier (Pvt. T.) was being treated for pneumonia, and early in the morning of October 23 the emergency night officer was called to administer to him for a headache. The officer detected what he thought to be the rash of a meningococcus septicemia on the patient's chest and sent for the ward surgeon on the meningitis service for consultation. This surgeon examined the man at 5.30 A.M. and found no evidence of meningitis or meningococcus infection, the rash having turned out to be typical acne. In order to be sure and satisfy himself, as well as the surgeon in charge of the case, of the correctness of the diagnosis, he made a lumbar puncture. The fluid

obtained was perfectly clear, contained but two white cells per c.mm. and no red cells. As a matter of routine (for no one suspected the patient of having a septicemia) a specimen of blood was taken for culture, which revealed the presence of a pneumococcus (Type I) infection. On the following evening (October 24) the patient began to show unmistakable signs of irritation within the central nervous system and a second spinal fluid withdrawn at this time (thirty-six hours after the first) gave positive evidence of meningitis, the infecting organism being the pneumococcus (Type I). Intraspinal therapy with the specific antipneumococcus serum was immediately instituted without effect and the patient died on the morning of October 25. Autopsy showed a typical pneumococcus leptomeningitis, with secondary hydrocephalus.

The two cases just recorded indicate the possibility of the removal of cerebrospinal fluid acting as a factor facilitating the infection of the meninges from the blood stream. In both of these patients an initial normal spinal fluid was obtained at the time of a positive pneumococcus septicemia. Subsequently, meningitis, caused by the same organisms circulating in the blood stream, occurred in both patients; death followed in twenty-four to forty-eight hours. In the first case the diagnostic puncture was made because meningitic symptoms were present; in the second the obvious purpose of the puncture was to complete the clinical study. On account of the absence of all signs of meningeal involvement at the time of the puncture the second case affords a close analogy to the observations made in this laboratory on experimental animals.

Meningococcus Infections. The appearance of a small epidemic of meningococcus infections at Camp Jackson during the latter part of October furnished material for a clinical consideration of the disease in a variety of its forms. Due to the skill in diagnosis acquired by the officers of the medical service at the base hospital and the watchfulness maintained by the regimental surgeons a relatively large number of the septicemic type of these infections was detected; many of the cases exhibited no clinical evidence of meningitis at the time the septicemia was diagnosed. Since certain of these patients were punctured at a time when the meninges were free from infection, opportunity was afforded to observe any relationship which might possibly exist between the performance of diagnostic lumbar puncture and the subsequent localization in the meninges of such blood stream infections. The influence of serum therapy in this relationship could also be studied.

There were among the cases observed three of the fulminating type of meningococcus septicemia. All of them were alike in that onset was sudden and the course of short duration—fifteen to twenty-four hours. Each patient was covered by a characteristic purpuric rash, so ably described by Herrick,¹⁶ but in none of them were there symptoms indicative of irritation within the central

nervous system. That an actual meningitis did not play an important part in the disease is demonstrated in part by the pathological study of the spinal fluid of one of these patients, a nurse, who died within twenty-four hours after the manifestation of the first clinical signs of systemic infection. A diagnostic lumbar puncture was performed just forty minutes before the patient died. The fluid then contained Gram-negative diplococci, with very slight increase of cells of the polymorphonuclear and mononuclear types (12 per c.mm.). Although an early meningitis was undoubtedly present it was in no degree comparable with the severity of the septicemia, which in this instance may be considered as the cause of death. Unfortunately no autopsy was procured.

In the second case, that of a soldier, E. A., the same picture was present; this man also died within twenty-four hours after the onset of his illness. During life no lumbar puncture was made, but a specimen of fluid obtained three hours postmortem contained but twelve cells with sugar and globulin normal. The culture was contaminated and revealed among other bacteria a colony of Gram-negative diplococci which did not grow on subculture sufficiently to type. No gross lesion of the central nervous system was seen at autopsy. The histological findings in the meninges were limited to an infiltration, with large mononuclear cells (arachnoid proliferation, Essick⁹), with scattered free red blood cells. The ependyma was normal.

The third case of the series, W. H., is perhaps the most interesting, for in it we have an excellent control for the other two. On admission, October 2, 1918, at 5.30 p.m., the patient had general aches and pains in the back, legs and joints, associated with headache and sore throat, the symptoms having started the day before. He was perfectly conscious and had no signs of meningeal involvement. The skin of the whole body, especially of the face and upper extremities, was very thickly sprinkled with ecchymotic areas. There were similar ecchymoses on the conjunctivæ. The patient objected to being moved on account of the extreme soreness of the muscles of the extremities. Neither stiffness of the neck nor Kernig was present. His temperature was 103° and his pulse 112. Blood culture on admission showed meningococcus and a white blood count made was 11,000. At the same time a diagnostic lumbar puncture was done. The spinal fluid was clear and contained but four cells per c.mm. (no red blood corpuscles.) The globulin content was not increased (Noguchi) and Benedict's solution was reduced. Repeated smears from the centrifugalized portion of the fluid showed neither pus cells nor meningococci, and cultures of the fluid were negative. No intraspinal serum was given. During the night the patient was given 160 c.c. and later 140 c.c. of Serum V (Rockefeller) intravenously. By 8.30 a.m. the next day he was markedly prostrated. Orientation continued normal, and at 10 a.m., though he was deeply

prostrated, he could be aroused, when his responses were still intelligent. His neck was not stiff, but all the deep reflexes were abolished. The patient died at 11.30 A.M. The pathological examination of the brain showed the presence of an early meningitis over the cerebral hemispheres.

These cases of fulminating meningococcus septicemia correspond in all respects to those reported by numerous authors and demonstrate the truth of Sophian's³⁷ statement that the clinical observations and postmortem examination bear out the fact that it is the general sepsis that kills. The third case of the above group represents, moreover, a possible relationship between the release of cerebrospinal fluid during a septicemia and the subsequent meningitis.

The next question to determine was whether such septicemias can go on to recovery without showing meningeal involvement, and though there are many such illustrations to be found in the literature, the following personally observed case (F. G. G.) is of interest. This patient was a convalescent from pneumonia and had had a normal temperature for five days. At 8 o'clock on the evening of October 25 his temperature suddenly rose to 103°, having been normal throughout the day; a morbilliform rash developed and the conjunctivæ became injected. Otherwise the patient did not feel badly and there were no signs of meningitis, although his appearance suggested a meningococcus septicemia. A blood count at 9.30 P.M. the same evening showed 23,000 white cells and a blood culture demonstrated Type IV (normal) meningococcus. Twelve hours later the man was seen again, when his temperature was 98°, pulse 68 and a second blood culture taken at this time remained sterile. Antimeningococcic serum was subsequently given intravenously, but there was never a recurrence of the fever, and the patient was not subjected to lumbar puncture.

In these few observations it was quite clearly demonstrated that the meningococcus, like other blood-stream invaders, may vary enormously in its pathogenicity, and even when present in its most virulent form, the fulminating type, the meninges may very well escape being affected.

It is also conceivable that under some circumstances in which the organism is attenuated the meningococcus may actually reach the meninges without producing an infection. This point is well illustrated by a case seen by us. This patient had a meningococcus septicemia, and though he showed no clinical signs of meningitis, he was subjected to lumbar puncture for diagnostic purposes; the puncture was made, however, after he had already received intravenous serum treatment. The spinal fluid obtained had a slight blood contamination, but was otherwise normal, except that in the culture (blood-agar plate) a single colony of meningococcus was found. This was the only lumbar puncture performed and the patient did not develop meningitis, although the organism may have

been in the subarachnoid space at the time the spinal fluid was withdrawn. The presence of the colony of bacteria in the culture was felt to be a result of the blood contamination. In any event it is hardly conceivable that the meninges in this instance could have escaped infection, for if the organisms were not already present within the subarachnoid space at the time of puncture there was the possibility of indirect and direct invasion from the blood stream. Such a localization of the systemic infection might be expected to follow the release of spinal fluid, and there was, in addition, the obvious pathway for direct contamination resulting from vascular trauma during the operation, as evidenced by the presence of red blood cells in the spinal fluid. That meningitis did not develop may be explained by assuming that the organisms had already lost their virulence, probably as a result of the previously instituted intravenous serum therapy. Furthermore, that the timely administration of intravenous serum therapy may result, not only in lowering the virulence of the meningococcus, but in actually killing the organism in the blood stream before it has a chance to localize in the meninges, is probably true also. At Camp Jackson we never expected a positive blood culture after the first dose of serum given intravenously. Two cases which came under our observation on the service of Major Herrick, at Camp Jackson, may be cited in point; in order to save time in treatment they were given serum intravenously as soon as the clinical diagnosis of meningococcus septicemia was made. Within the next twelve hours after the serum had been given, specimens of blood and spinal fluid from both cases failed to show the presence of organisms and both patients went on to recovery without developing meningitis. Similarly, a third case, diagnosed clinically as a meningococcus septicemia, was given serum intravenously before blood and spinal-fluid specimens could be obtained. It was not until two weeks later when the patient came down with recurrence of the infection, during which he developed a typical meningitis, that any positive laboratory data were obtained on the case. The early use of intravenous serum successfully overcame the infection in the blood stream of two of these cases before the meninges were affected and without the intraspinal therapy. It is not known where the third patient was harboring the focus of infection which was responsible for his relapse. The blood stream was thought to have been cleared of microorganisms and serum therapy had consequently been discontinued a week prior to the recrudescence. The patient never showed any signs of irritation of the central nervous system before the development of the meningitis subsequent to his relapse.

In the cases so far considered the study of the relationship between a diagnostic lumbar puncture during a meningococcus septicemia and any subsequent reaction displayed by the meninges has been complicated by several factors, namely, the fulminating

type of the blood stream infections in the first cases and the early intravenous treatments with serum in the others. It was with great interest therefore that two cases of meningococcus septicemia which were punctured for diagnostic purposes during a period of blood stream invasion, before serum was administered, were followed.

The first of these, a soldier, J. J. S., was recovering from lobar pneumonia and his temperature, normal since October 4, suddenly rose to 103° at 11.00 P.M. on October 20. His pulse at the time was 120. He said that he had pain in his legs and a slight headache for the past three days. His neck was not stiff and his reflexes were all normal. There were on his abdomen and back a few small spots which looked like flea-bites, but there were no petechiæ. The following morning his temperature was 102° , but his appearance was normal, and he said that he felt well. At this time there were many small petechiæ on the chest and upper arm. There was slight Kernig but no rigidity of the neck. A blood culture taken at this time showed meningococcus, Type IV. A lumbar puncture was done at the same time and the fluid obtained was clear, contained 13 white blood cells and 600 red blood cells per c.mm. The globulin was negative and Fehling's solution was reduced. No organisms were seen in the smear from the centrifugalate and cultures of the fluid remained sterile. No serum was given intraspinaly at this time, but intravenous treatment was started shortly afterward. On the second day (October 22) the signs of meningeal irritation were marked and a second lumbar puncture at this time yielded a cloudy fluid in which the pus cells formed a thick sediment. Smears from this sediment showed pus cells in quantities, as well as intracellular and extracellular Gram-negative diplococci. Intraspinal serum treatment was then instituted along with the intravenous treatment, and with this the patient made an uneventful recovery.

The second case, Ed. W., came in on October 2, 1918, with influenza and developed a bronchopneumonia on October 7. He was making satisfactory progress and was running a normal temperature until 8 P.M. on October 18, when it rose to 104° . He developed a macular rash which disappeared on pressure. He had no rigidity of the neck and no headache, but had vomited and was uncomfortable. Blood culture at this time gave meningococcus, Type IV (normal). Lumbar puncture was done at 10 P.M., and the spinal fluid was clear, containing 20 white and 15 red blood cells. Noguchi's test indicated no increase in globulin. Benedict's solution was reduced and cultures were negative. Smears of the centrifugalate of the spinal fluid showed no polymorphonuclear leukocytes or organisms. The next morning at 10.20 the spinal fluid was cloudy and contained 4320 white blood cells, and numerous organisms were seen in the smear. Clinical signs of meningitis were present and the patient was semiconscious. He died on the morning of the second day (October 20). Autopsy demonstrated a widespread meningitis

covering both cerebral hemispheres, with beginning invasion of the ventricles.

In both of these last cases there was some blood contamination of the spinal fluids at the first puncture, and it might well be said that infection in each of them, if the result of the puncture, should be attributed to direct infection of the meninges through injury of a bloodvessel by the exploring needle. This possibility must, of course, be kept in mind, but experimentally it has been found that in the production of meningitis by the release of spinal fluid during septiciemias the direct infections from vascular injury at the site of puncture can be excluded as a factor. In the second case (Ed. W.) the slight increase in white cells in the first fluid may be interpreted by some as an indication that an early meningitis was already present. But an increase in the mononuclear content of the cerebrospinal fluid, though not always manifest, is nevertheless so frequent an occurrence in most febrile and toxic conditions that it is a question, when the phenomenon is present, whether it should not be looked upon as a normal, probably defensive reaction of the meninges during such conditions. A case illustrating this reaction presented itself the same evening that the patient here referred to was examined, and concerned itself with a colored soldier, who on account of certain general symptoms was suspected of having meningitis. A lumbar puncture was performed and the fluid was found to contain 30 white cells per c.mm., all mononuclears, but no organisms. Two days later the man died and at autopsy bilateral bronchopneumonia and peritonitis, but no meningitis were found. A second specimen of spinal fluid obtained immediately after death contained 27 white cells per c.mm., all mononuclears; cultures remained sterile.

With the exception of the first case of pneumococcus infection all of the patients cited thus far were free from clinical signs of meningeal involvement at the time they were first punctured. Such punctures were not made to institute prophylactic measures, for serum was not injected at the time, in accordance with a rule, established at this hospital, that such therapy was only to be administered when the first fluid obtained by lumbar puncture was found to be pathological. This precaution was taken following the published observations of Flexner and Amoss¹⁰ on poliomyelitis, and later of Austrian³ on meningococcus septiciemias with respect to the effect of the introduction of serum into the subarachnoid space upon the localization of a blood stream infection in the meninges. If the cases of meningococcus infection are considered it will be seen that, with the exception of the fulminating case, those who had received intravenous serum therapy before lumbar puncture was done, showed subsequently no evidences of meningeal infection (without serum having been given intraspinally), whereas those who were punctured early, before measures had been taken to destroy or attenuate the organism present in the blood stream, developed meningitis the following day.

In the first group the withdrawal of spinal fluid served no other purpose than to support the clinical diagnosis that the meninges had not been invaded, and so far as beneficial result was concerned the procedure could very well have been dispensed with. In the second group, since positive signs of meningitis were lacking, delay in lumbar puncture until intravenous therapy had been started would have been logical; under the circumstances no good was accomplished beyond the substantiation of a fact which was already clinically apparent. On the other hand, the subsequent development of meningitis suggests rather strongly, in view of the ease with which experimental meningitis is produced by similar procedures, that actual harm was done.

REVIEW OF LITERATURE. A survey of the literature has revealed that meningitis not infrequently occurs shortly after normal spinal fluid has been obtained by lumbar puncture. In these reports the interpretation of the findings has varied greatly, but in no instance has the withdrawal of spinal fluid itself been suggested as a possible cause of the subsequent infection in the central nervous system. Unfortunately, many of the case histories do not contain records of blood cultures. Even without such data, however, the relationship between the diagnostic puncture and the pathological changes in the meninges following it, is significant enough to suggest the importance of the withdrawal of spinal fluid as a factor in the localization of infection within the central nervous system.

Arnold Netter was one of the earliest to appreciate the importance of the relation of blood stream infections to meningitis and sought in animal experimentation the solution of this relationship. As early as 1887 he was able, after cauterizing the brain surface through a trephine opening, to cause a localization of the pneumococcus in the meninges of rabbits following intrapulmonary inoculation of the organism. Following this observation, Netter^{24 25} has repeatedly emphasized the importance of blood stream infections as antecedent to meningitis. As a result his attention has been particularly drawn to a study of early meningitis and the condition of the spinal fluid in the first stages of the disease. Commenting on these early fluids, obtained during the first twenty-four hours of illness, this author says that three of the four observed were clear, contained flocculi of fibrin and were rich in organisms but poor in cells. The second fluids were always cloudy. On the other hand, in 6 cases out of 11, punctured for the first time more than two weeks after the onset of illness, the fluid was clear, but the Weichselbaum organism could not be demonstrated either by direct smear or culture in 5 of them. The second fluids, obtained twenty-four hours later, contained both pus cells and organisms. Unfortunately there is no record of blood cultures in these cases, although with the long duration of symptoms without earlier localization in the meninges, one is almost justified in assuming a general infection to have been present. Commenting

on this same type of case in 1911, Netter and Debre²⁷ note that in contrast to the impossibility of finding the Weichselbaum organism in clear fluids in which the cells are either rare or absent, the diplococci are easily found after the second puncture, when the fluid becomes cloudy and contains polymorphonuclear cells. As a result of such observations Netter has repeatedly, with Debre²⁶ and with Salamier,²⁸ insisted on the immediate subarachnoid injection of antimeningococcic serum in suspected cases of epidemic meningitis even though a clear fluid containing no organisms is obtained on lumbar puncture. Netter has himself reported cases of meningococcus septicemia which did not develop meningitis and recovered from the infection without the use of intraspinal serum therapy. The fact, moreover, that some of the cases of meningitis reported by this observer did not give evidences of meningeal involvement until after a diagnostic lumbar puncture was performed, indicates that the operation may in some instances have been the cause of the localization of the organisms in the central nervous system.

Achard and Laubry,¹ in reporting 3 cases of pneumococcus meningitis, included 1 of a man on whom lumbar puncture yielded 40 c.c. of clear fluid containing neither cells, sediment nor bacteria. Cultures of the fluid, as well as inoculation experiments, proved negative. The following day the patient died and at necropsy an exudate was found covering the entire surface of both hemispheres but especially marked along the vessels. Bacteriological examination of the exudate showed the presence of pneumococcus. The authors conclude that to explain the negative character of the spinal fluid of the day before there must have been a walling-off and lack of communication between the cerebral and spinal subarachnoid spaces, probably by adhesions. This would not satisfactorily explain why they got 40 c.c. of fluid by puncture. They note, moreover, that other meningeal lesions of the cranial cavity may give a clear fluid at lumbar puncture and cite a case of a hemorrhage covering part of a hemisphere in the presence of which lumbar puncture done shortly before death furnished a clear fluid without red cells or leukocytes. With these observations as a basis the authors conclude that whereas a positive fluid gives the diagnosis, a negative one does not exclude meningitis. The inference they make here is that the inflammation in the one case and the hemorrhage in the other were present at the time the fluids were obtained. In the light, however, of what we know concerning the effect of the release of cerebrospinal fluid on the meninges and possibly on the choroid plexus it may well be asked if in both of these cases the lumbar puncture was not partly responsible for the phenomenon noted postmortem.

Voisin³⁹ studied the spinal fluids of 45 children who were suffering from pneumonia of various types and did not show signs of meningeal irritation. Of these 2 developed meningitis subsequent to the lumbar puncture, 1 in four days and 1 at the end of a month; in

both cases the fluids obtained at the first puncture were normal. In addition to these this observer also investigated the spinal fluids of 38 cases of pneumonia among children who showed clinical signs of meningeal involvement. In 3 of these in which at the first puncture, and even at the second, not a single cell could be found a definite leukocytic reaction was subsequently present. In 2 others in which only a feeble cellular reaction was present at the time of the first puncture there was a marked reaction at the second. Only four fluids were observed which were actually cloudy, the turbidity appearing at the second puncture in two, the first fluids in both having been clear.

The same author with Laignell-Levastine⁴⁰ studied the brains of fifteen children, dying of pneumonia, on whom spinal-fluid analyses had been previously made *intra vitam*. Seven of these cases, from which normal spinal fluid had been obtained, showed pathological changes in the central nervous system. The authors observe that in all cases in which there was a leukocytic reaction of the fluid obtained *intra vitam* there was found also an inflammation of the meninges postmortem, but, on the other hand, they were able to find a reaction on the part of the meninges postmortem without leukocytes having been seen in the spinal fluid antemortem. They conclude, therefore, that inflammation of the meninges precedes, in certain cases, the appearance of leukocytic reaction in the fluid obtained by lumbar puncture.

Some years later Hutinel and Voisin¹⁷ reported cases in which the spinal fluid obtained *intra vitam* was normal in all respects, but at autopsy meningitis was found. The pathological condition, they add, was absolutely confirmed, and one could suppose that there must have been an obstruction to the foramina of Luschka and Magendie or of the spinal canal itself, either by exudate or anatomical variation, to account for the negative character of the spinal fluids obtained by lumbar puncture antemortem. Dalmenesche,⁶ in 1910, noted that the primary fluid of acute meningitis may be clear and free of organisms. Sladen,³⁵ in the same year, in reporting 23 cases of epidemic cerebrospinal meningitis, calls attention to the frequency with which the complete change in character of the spinal fluid has been noticed to follow lumbar puncture.

Vincent³⁸ recalled, in 1909, a case which he had observed two years before, in which the primary fluid was clear, contained a normal number of lymphocytes and showed no organisms, either on smear or culture. Three days later a second lumbar puncture yielded a cloudy fluid, containing polymorphonuclear cells and meningococci.

Levy¹⁹ in reporting 165 personally observed cases mentions the case of a boy on whom he performed lumbar puncture for diagnostic purposes. The spinal fluid obtained was clear and cultures of it were sterile. The case rapidly developed a turbid fluid in which

the diplococci were subsequently found; the patient died after sixteen hours.

Sophian³⁷ recognizes that not infrequently suspected cases of meningitis are punctured at a time when the fluid is not only clear but sterile, and then at subsequent punctures the typical cloudy fluids of acute meningitis containing the characteristic organisms are found. As the majority of cases of meningitis are preceded by a septicemia there is, before frank purulent meningitis has established itself, a period (the accumulative stage), the author thinks, during which the fluid is clear and sterile but increased in amount. As an example of this stage is given the case of a woman from whom 40 c.c. of clear cerebrospinal fluid under high pressure was obtained on lumbar puncture. Examination of this fluid failed to show the presence of bacteria or any increase in cells. Twenty-four hours later a second fluid was turbid and contained many pus cells and bacteria.

Lundie, Thomas and Flemming²¹ state that not a case of epidemic cerebrospinal meningitis yet noticed in their command (English Army) has failed to present pus and meningococci in the spinal fluid, and only such cases have been used in estimating mortality. Some of these cases reported by these authors gave clear sterile fluids at first lumbar puncture, containing no pus or formed elements.

Robson and Gould,³⁰ in 1915, reported 31 cases of cerebrospinal meningitis. With two exceptions the first lumbar puncture invariably yielded turbid fluid in which meningococci could be demonstrated. Of these two the first case was that of a boy who was taken sick with clinical signs of meningitis. A lumbar puncture was done; the fluid was clear, under no increase of pressure and cultures remained sterile. The following day the signs persisted, but lumbar puncture again produced clear fluid. On the third day his condition was about the same and lumbar puncture gave clear fluid for the third time. A blood culture taken on this day was positive, yielding typical meningococci. On the fourth day the spinal fluid was opalescent and permitted the diagnosis of meningitis.

The other case referred to by these authors was one in which a clinical diagnosis of meningitis was made on admission, but the spinal fluid obtained at that time by lumbar puncture was clear and cultures of it remained sterile. The next day a second lumbar puncture yielded a fluid which was turbid and contained meningococci.

Foster¹¹ in reporting 150 cases of meningitis remarks that for an accurate diagnosis bacteriological tests alone are trustworthy, for, he says, one may frequently obtain two or three perfectly clear fluids before one is withdrawn in which there occurs an abundant growth.

Worcester, Drought and Kennedy⁴⁶ mention an interesting case, that of a man, aged twenty-six years, who was admitted to a hospital in collapse and with a temperature of 103°. His appearance

strongly suggested a fulminating case of cerebrospinal fever, but he presented no signs of meningitis. A lumbar puncture revealed perfectly clear spinal fluid, containing no increase in cells, in which no organisms could be found, either in direct smear, centrifugalized sediment or culture. A blood culture taken at this time showed meningococcus (Type II of Gordon.) By evening there was some rigidity of the neck and Kernig sign was positive. A second lumbar puncture gave turbid fluid containing polymorphonuclears and lymphocytes as well as several pairs of Gram-negative diplococci.

Recently, Herrick,¹⁶ as a result of his observation of 265 cases of epidemic meningitis at Camp Jackson, says that the spinal fluid in the stage of meningococcal sepsis, as in other acute febrile diseases, may or may not be under increased pressure, and may or may not show a trace of globulin. The cells are not increased. If organisms are not found in the fluid obtained by the first lumbar puncture they frequently appear in that obtained by the second three or four hours later. That the meningococci first invade the cerebrospinal spaces in the region of the choroid plexus seemed clear to this writer for in some of his cases of meningitis he found it necessary to make repeated lumbar punctures at intervals of two hours before a fluid which contained organisms was obtained. He concluded that the bacteria were brought down by drainage. Furthermore, in two fulminating cases, with speedy death, the spinal fluid obtained by lumbar puncture shortly before death contained no organisms while that secured at necropsy from the lateral ventricles showed numbers of meningococci.

That meningitis does not always follow if lumbar puncture is performed during a septicemia cannot be denied, for the virulence of the organism may be such or its pathogenicity for the meninges may be so modified that its introduction within the subarachnoid space would be harmless. Mention has already been made of a case, seen at Camp Jackson, from which a clear normal spinal fluid was obtained at a time when the blood stream was infected with the pneumococcus and also one in which a blood-contaminated specimen of spinal fluid was culturally positive for meningococcus. Neither of these patients developed meningitis and both went on to complete recovery. Aside from these cases there are several to be found in the literature which in some particulars are similar.

Liebermeister,²⁰ in 1908, reported a case of meningococcus septicemia without meningitis, in which blood cultures taken seventeen days apart showed the presence of the organisms, whereas two lumbar punctures taken in the interval, one six days after the first and the other the day before the second blood culture, were negative.

A case of Loiseleur and Monziol²³ had been running an intermittent fever for sixteen days, at the end of which time a lumbar puncture gave a negative fluid. Three days later, the symptoms continuing, a blood culture was taken and revealed a meningococcus

infection. Similarly in the case of Sainton and Maille³⁴ the blood was not cultured until two days after the lumbar puncture was performed. The patient never had any symptoms referable to irritation of the central nervous system, but the explanation was suggested by the presence of a purulent (meningococcic) arthritis.

Bovaird,⁴ in 1909, published a case of a young girl who was suspected of having epidemic cerebrospinal meningitis. A lumbar puncture, however, gave 20 c.c. of a clear normal fluid under normal pressure, as a result of which the opinion was changed to that of hemorrhagic purpura. Four days later a blood culture was positive for meningococcus. On the eighth day after admission a second blood culture was sterile, as was also a specimen of blood-stained spinal fluid obtained by lumbar puncture.

Sacquepee³³ reports a case of typhoid fever with meningeal symptoms in which the spinal fluid the day of admission was under slightly increased pressure, contained a moderate increase of lymphocytes, but on culture proved to be sterile. A blood culture at the same time showed both streptococcus and *B. typhosus*, but there is no note of the case subsequently developing meningitis.

That meningitis does not always follow if a lumbar puncture is performed during certain septicemias should not be permitted to cloud the real issue, for in spite of the exceptions given there is sufficient evidence, it seems, of both an experimental and clinical nature to indicate the need for greater caution in the performance of an operation, which may do harm.

LIMITATIONS FOR THE USE OF LUMBAR PUNCTURE. Recently, there has been a tendency on the part of clinicians to multiply the indications for performing lumbar puncture on patients suspected of having meningitis, until now all that is needed to justify the procedure in the minds of some writers is a history of contact and possibly some clinical evidence of infection. Gillett¹² in discussing the diagnosis of meningism urges that lumbar puncture should be performed at the earliest possible moment and not, as is often the case, only when the condition has become markedly indicative of meningeal irritation, for, he says, it can do no possible harm. Netter,²⁵ in referring to the symptoms of meningococcus septicemia, states that in every case there should be no hesitation in performing lumbar puncture on the smallest doubt. Robson and Gould³² in their report of thirty-one cases speak of the procedure as a slight operation which is in no way dangerous and is of great importance in establishing a diagnosis. It is well to recall that in this same series these authors report two cases, quoted above, which developed a true meningitis after such diagnostic punctures. Foster¹¹ learned from his cases that clinical symptoms could not be relied upon for a diagnosis of meningitis. He advises early puncture, since he feels that bacteriological tests of the spinal fluid alone are trustworthy.

Herrick,¹⁶ after enumerating the manifold symptoms incident to

the septicemic stage of meningococcus infections, asserts that the clinical suspicion aroused by any combination of two or more of them demands lumbar puncture.

The reason for this extreme measure has its explanation in two sources: (1) the belief that the lumbar puncture itself can do no harm, and (2) the demonstration in recent years of the primary septicemic nature of meningococcus infections. Concerning the first of these reasons, enough has already been said to indicate that the withdrawal of the needle does not end the changes initiated by the release of spinal fluid; but to appreciate the second, one must understand clearly the successive stages in the establishment of the proof that epidemic meningitis is a primary blood infection.

In 1899 Gwyn¹⁵ isolated for the first time the meningococcus from the blood stream. Solomon³⁶ was able to confirm the observation in 1902, and in the following year Warfield and Walker⁴¹ published another case. Opportunities for the further observation of this phenomenon were afforded by the great pandemic of 1905-06, so that in the first of these years Elser⁷ was able to report 10 positive meningococcus blood cultures out of 41 observations. In the same year Lenhartz,¹⁸ Morton and Rhode²² and Weichselbaum and Ghon⁴⁵ published isolated cases. All of these, however, were inconclusive in that they did not demonstrate the primary nature of the septicemia, for in all of them except that of Warfield and Walker, in which autopsy was refused and no spinal fluid analysis is recorded, the first lumbar puncture demonstrated that the meninges were already the seat of infection. Thus, many writers continued to accept the teachings of Westenhoeffer,⁴⁴ who, while admitting the possibility of a dual pathway of infection for the meninges, namely, by the blood and lymph, felt that the direct extension from the pharynx and the sinuses surrounding the cranial cavity along the nerves and lymphatics was the real explanation. However, cases continued to be reported of meningococcus septicemia complicating meningitis, Goepfert¹⁴ and Robinson.³¹ Andrew's case,² a fulminating one, from the blood of which the meningococcus was isolated *intra vitam*, showed at autopsy an extravasation of blood in the meninges, but no meningitis. This demonstrated for the first time that the blood invasion could of itself cause death without first affecting the meninges. The report was followed in 1908 by a case of Liebermeister,²⁰ referred to above, in which two lumbar punctures taken during a meningococcus septicemia proved to be sterile. This patient recovered from the septicemia, thereby definitely proving that a primary meningococcus septicemia could go on to recovery without being associated with meningitis. In 1909 Elser and Huntton,⁸ in their excellent bacteriological studies of the disease advance the opinion that all of the evidence adduced up to that time pointed to the hematogenous origin of meningococcus meningitis. Since then the idea of direct extension of the organisms from the

mouth and sinuses into the cranial cavity has gradually lost support, the present conception of the process of infection being that the organisms gain access to the body probably in the upper respiratory passages; thence they invade the blood stream and produce local lesions by metastasis.²¹ The diagnosis of meningococcus septicemia has been gradually facilitated by the clinical observations in recent years of Netter,²⁵ Bovaird,⁴ Gioseffi,¹³ Sophian,³⁷ Lundie, Thomas and Flemming,²¹ Worcester, Drought and Kennedy,⁴⁶ Foster,¹¹ Herrick,¹⁶ etc., so that the disease has assumed a place for itself among the acute infections.

At the time that Jochmann and Flexner were testing out their sera (1905-07) it will be seen that the septicemic nature of meningococcus infection had not become very generally accepted, so that serum therapy, though attempted occasionally subcutaneously, became limited practically to the intrathecal route. With the growing conviction, however, that the meningococcus produces a primary systemic infection it gradually became apparent to clinicians that serum should be administered in such a way that it would reach the organisms within the blood stream as well as those in the meninges. Accordingly the intravenous injection of serum has been recommended among others by Chevrel and Bourdinier,⁵ Penna,²⁹ Sophian³⁶ and Herrick.¹⁶

Notwithstanding the evidence that the meningococcus may exhibit all degrees of virulence within the blood stream without involvement of the meninges, from a fulminating infection with death in a few hours to such mild infections that recovery follows in a day or two, the appearance of signs of meningococcus septicemia are still accepted as certain forerunners of meningitis. On the assumption that lumbar puncture can do no harm, spinal explorations are practised on such patients even though they show no clinical signs of infection within the central nervous system. The logical way to handle both types, it seems, would be to treat the blood infection by intravenous therapy and avoid lumbar puncture at least until signs of involvement of the meninges are present. Such a procedure proved effective in several of Penna's cases, for in two instances in which intraspinal treatment was controlled by intravenous he found that the patients did equally well. Monziols and Loiseleur²³ report a case of meningococcus septicemia with focal infection of the pleura. As there were no meningeal symptoms lumbar puncture was not performed and the case cleared up under pleural injection of serum. Herrick also reports the case of a nurse with meningococcus septicemia who got well under intravenous administration of serum alone. A similar case, personally observed on Major Herrick's service, had already been mentioned.

When, during a meningococcus septicemia, definite signs of irritation in the central nervous system have developed there is not much choice left but to make the puncture, for in such cases if the

actual infection is not present and the symptoms have been due to accumulation of fluid or irritation resulting from the toxins of organisms one has in serum therapy a means of repairing any damage that may later show itself.

If a septicemia with any one of the pyogenic organisms other than the meningococcus is present it is questionable whether lumbar puncture should be performed in some instances even though signs of meningitis are present. Such organisms, when present in the subarachnoid space, usually cause a fatal meningitis, and until some methods are found whereby a cure or an amelioration of symptoms can be accomplished the demonstration of a cloudy fluid under the circumstances does little good except to establish the diagnosis. Were our methods of diagnosis more accurate, so that the obtaining of a cloudy infected fluid could be foretold with certainty, the objections to the procedure would not be so strong. This is not the case, however, for so frequently are the symptoms usually associated with meningitis displayed during acute infections that lumbar puncture, even in what are apparently unmistakable cases of meningitis, becomes in reality an exploratory operation. The frequency with which clear fluids are obtained in such cases is evidenced by the copious literature on the subject. The "Meningismus" of Dupre, the "serous meningitis" of Quincke,³⁰ the "meningotyphus" of Sacquepee,³³ the "sympathetic meningitis" of Netter and numerous other designations used to cover these clinical paradoxes are but expressions indicating the frequency with which symptoms of central nervous system irritation are found without bacterial invasion of the meninges.

The phenomenon of producing meningitis by the withdrawal of spinal fluid during septicemias is felt to be due in part to physical factors involving the disturbance of pressure relations within the cerebrospinal cavity. If this is true it would seem that the chance of producing such an infection would be directly proportional to the amount of spinal fluid removed. In the animal experimentation, however, it was found that puncture of the occipito-atlantoid ligament without withdrawal of fluid had the same effect as actual withdrawal. The explanation for this proved to be that after such a procedure a definite leakage of fluid takes place into the soft tissues of the neck through the opening made in the dura. Before this was determined it was hoped it would be possible to reduce the incidence of subsequent meningitis in man by limiting the removal of fluids to minimal quantities sufficient only for diagnostic purposes. But the same factors of leakage of spinal fluid into the surrounding tissue through the hole made by the needle in the spinal membranes are present in man as well. The use of needles having small diameters would doubtless aid in reducing such leakage and is consequently to be recommended.

SUMMARY. It had been found, clinically, that infections of the meninges occur not infrequently following the release of normal spinal fluid by lumbar puncture during a septicemia. Five such observations have been made personally and similar cases have been found in the literature. The close analogy existing between these cases and certain experimental observations reported elsewhere indicate that the withdrawal of spinal fluid should be seriously considered as a causative factor in the production of meningitis under certain conditions. To prevent the possible accidental production of a meningitis as a result of diagnostic lumbar puncture it is recommended (1) that careful consideration be given the bacteriological study of the blood before such punctures are attempted; (2) that in acute diseases, in the absence of definite signs of irritation of the central nervous system, lumbar puncture should be avoided unless it is first conclusively shown that the blood stream is free of infection; (3) that when the clinical symptoms are such as to render a lumbar puncture advisable, minimal quantities of fluid should be withdrawn, sufficient only to permit necessary laboratory tests to be made; (4) that small-bore needles should be utilized in performing the operation to prevent as much as possible subsequent leakage of spinal fluid into the surrounding tissues.

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RELATIONSHIP OF THE STREPTOCOCCUS HEMOLYTICUS TO "INFLUENZA" AND PNEUMONIA.¹

BY CAPTAIN M. B. LEVIN, M.C.,

FIRST LIEUT. D. A. GOODMAN, M.C.,

AND

SECOND LIEUT. F. J. PANCOAST, S.C.,

U. S. ARMY GENERAL HOSPITAL NO. 2, FORT MCHENRY, MARYLAND.

In reviewing the laboratory work of all cases of "influenza" and pneumonia, many of which were admitted with the diagnosis of influenza, as diagnosed at our hospital from September 1, 1918, to October 20, 1918, our attention was called to the very common association of *Streptococcus hemolyticus* with these conditions, and an attempt was made to summarize the laboratory work on all such cases from September 1, 1918, to January 1, 1919. We also referred to previous reports to the Surgeon-General's Office dated July 20, 1918, and October 19, 1918.

No attempt was made to try to differentiate hemolytic streptococci on other sugars than glucose and lactose and in the results we referred to the organisms only as their hemolytic action on blood was concerned.

A bacteriological summary of 554 sputa examined showed a great predominance of *Streptococcus hemolyticus* over other organisms.

¹ Read before the Weekly Staff Meeting at U. S. A. General Hospital No. 2, Fort McHenry, Maryland, February 5, 1919.

Bacteriology of Sputum (All Typed for Pneumococcus) and Throat and Nose Cultures from September 1, 1918, to January 1, 1918.

	Per cent.	Per cent.
Pneumococcus type I	4 (12)	0.72
Pneumococcus type II	3 (9)	0.54
Pneumococcus type III	5 (14)	0.92
Pneumococcus type IV	22 (65)	3.975
Total pneumococcus	34 (100)	6.155
Bacillus influenza	7	1.265
Micrococcus catarrhalis	2	0.36
Staphylococcus aureus	5	0.92
Streptococcus hemolyticus	506	91.30
Total	554	100.00

In considering the above results it must be borne in mind that a great percentage of apparently normally healthy individuals carry Streptococcus hemolyticus in throat cultures, but rarely as high a percentage as the above. A brief summary of our carrier report of July 20, 1918, follows:

Carriers of Streptococcus Hemolyticus Reported to the Surgeon-General's Office July 20, 1918. In a series of 100 apparently normal individuals, surgical and other patients on our wards not suffering from influenza or pneumonia, the cases having been taken at random and not selected, 55 per cent. showed Streptococcus hemolyticus positive in throat cultures and 45 per cent. negative. This was during the months of May, June and July, when we had very little of our respiratory diseases. Among the Streptococcus hemolyticus empyemas and pneumonias when put out in the open air and sunlight there was a marked drop in the number of positive cultures in the throat and affected secretions. When removed from this into the wards there was a marked increase again in Streptococcus hemolyticus carriers.

A Summary of Antemortem Blood Cultures:

	Per cent.
Pneumococcus type IV	1.62
Streptococcus viridans	1.62
Sterile	96.76
Total	100.00

A Summary of Postmortem Heart and Lung Cultures in First Fourteen Taken:

	Per cent.
Pneumococcus type IV	7.0
Streptococcus homolyticus	93.0
Total	100.0

A Summary of Combined Antemortem and Postmortem Cultures:

		Per cent.
Pneumococcus type IV	2	2.6
Streptococcus hemolyticus	13	17.2
Streptococcus viridans	1	1.3
Sterile	60	78.9
Total	76	100.00

(Of all organisms found the Streptococcus hemolyticus, 81 per cent.).

A Summary of Pleural Cultures Antemortem:

		Per cent.
Pneumococcus type IV	2	8.4
Streptococcus hemolyticus	8	33.3
Sterile	14	58.3
Total	24	100.00

A Summary of Pleural Cultures Postmortem:

		Per cent.
Pneumococcus type IV	1	1.8
Streptococcus hemolyticus	53	98.2
Total	54	100.00

A Summary of Pleural Cultures Antemortem and Postmortem:

		Per cent.
Pneumococcus type IV	3	4.3
Sterile	14	20.0
Streptococcus hemolyticus	53	75.7
Total	70	100.00

The Media Used for Cultivation. The media most commonly used were 0.5 to 1 per cent. glucose or dextrose blood-agar and bouillon. At first when such overwhelming percentages of Streptococcus hemolyticus in pure cultures were found it was thought best to try other media to bring out other types of organisms—Loeffler's blood serum, sheep serum, dextrose agar, Russell's double and triple sugar media, hemoglobinized inspissated dextrose sheep serum, etc., were tried in numerous cases, with the same findings of a large percentage of Streptococcus hemolyticus. The best medium for the growth of the hemolytic streptococcus in our experience was 1 per cent. blood-dextrose bouillon, the blood in nearly all cases used in 5 to 10 per cent. proportions having been human blood citrated. In this medium growth was very profuse, hemolysis rapid, acid production marked and in the medium near the surface acid hematin was rapidly formed. If kept five to ten days sterile subcultures were often obtained, due to the organisms killing themselves. The streptococci occurred typically in diplostreptococcus form of varying lengths, in chains containing from four to six or more, the longer chains having more "coffee-beaned" forms. They stained readily with most of the anilin dyes, and were Gram-positive. They were

facultative anaërobes growing profusely in partial anaërobiasis, but free access of oxygen, however, furnished the most suitable environment for growth. In the blood-dextrose broth the colonies grew characteristically spreading up along the sides of the test-tube on the blood-dextrose agar appearing as tiny, pin-pointed, moist and almost transparent droplets surrounded by a clear and well-defined zone of hemolysis. With discrete colonies this zone was circular and varied in diameter from one-eighth to one-half inch.

The mouse method as devised by Avery and the artificial culture method were employed in the usual manner for our typing.

Urine Examination of Pneumonia and Influenza Cases. Up to October 20, 1918, 500 specimens were examined, of which over 25 per cent. showed albuminuria. None showed glycosuria. From September 1, 1918, to January 1, 1919, the total number of urines examined was 1082. A summary of the findings follows:

		Per cent.
Albumin	121	11.18
Albumin and casts	198	18.30
Total albumin	319	29.48
Normal urines	763	70.52
Total	1082	

A large number of urines showed blood microscopically and some grossly. The toxicity of the urine up to 5 c.c. for animals when it had been filtered through a porcelain (diatomaceous) filter was nil. No precipitins or agglutinins were found in the urine against the *Streptococcus hemolyticus*. Unfortunately we could not carry out other chemical or metabolic studies on these urines during the emergency.

White Blood Counts made on Pneumonia and Influenza Patients. The total number of white-blood counts made was 444. The counts were higher in uncomplicated cases in which the patient recovered. In fatal or complicated cases the counts were lower. The average count throughout the whole series was 11,800. The differential counts varied between normal or, in the pneumonia cases especially, slight polymorphonuclear increase. Up to October 20, 1918, the average white-blood count was between 4000 and 6000, a noticeable leukopenia at times. From October 20, 1918, to January 1, 1919, the average white-blood count was between 15,000 and 20,000:

Attempts were made to determine where, in the body, the greatest fight was taking place and what tissues and fluids in the body were entering into the struggle for immunity and how.

The Opsonic Index on Streptococcus Hemolyticus Pneumonia Cases. The white count of very few patients showed any aggression at all to *Streptococcus hemolyticus*. In the experiments we found that in pneumonia and influenza, cases infected with *Streptococcus hemolyticus* showed very little aggression even toward such organisms as staphylococci.

The opsonic index during the course of the disease, both previous to and after the crisis, was slightly lower than normal. This tended to show how little in general the white cells fought in these cases.

Toxic filtrates of *Streptococcus hemolyticus* cultures for mice, rabbits and less for guinea-pigs were obtained, but were not comparable in potency to similar filtrates of diphtheria and tetanus cultures. The destruction of the red-blood corpuscle was due to a specific hemolysin produced by the organism in its growth. Marked hemolysis occurred early before a culture of hemolytic streptococcus developed any marked or definite acidity, showing that acidity was not the cause of the hemolysis here, although it may later have entered into the reaction. In dextrose broth cultures the filtrate, which was quite acid, was neutralized accurately and a red cell suspension added to it, with hemolysis resulting. Some investigators believe there is a direct relationship between virulence and hemolytic action, others that the hemolytic power is a constant and fixed characteristic of certain strains. Observation here indicated that the property of hemolysis is a fixed and racial characteristic of certain streptococci and that the virulence of these strains may be enhanced by animal passage and reduced by cultivation on artificial media.

In one of our cases in which the pleural fluid was teeming with hemolytic streptococcus we had some citrated normal blood for hemolytic tests and added some pleural fluid to the whole blood to see if the organisms would grow in it. After forty-eight hours, incubation no subcultures of *Streptococcus hemolyticus* could be obtained. In looking into the matter we found that 10 per cent. sodium citrate was used by mistake and determined to learn whether sodium citrate was antiseptic for the *Streptococcus hemolyticus* and in what strength. *Streptococcus hemolyticus* was incubated with sodium citrate from 80 per cent. strength down to 0.5 per cent. for twenty-four hours, then subcultured in blood-dextrose broth. No subcultures were positive down to 2.5 per cent. All from there down were positive. This factor might be of some value in the use of sodium citrate for blood cultures, transfusions and possibly by mouth or other methods in the treatment of *Streptococcus hemolyticus* infections, general or local.

Normal human blood serum showed no agglutinins or precipitins against *Streptococcus hemolyticus* in dilutions up to 1:1000. Guinea-pigs were immunized by gradually increasing doses of *Streptococcus hemolyticus* vaccine from 250,000,000 upward and showed agglutinins against *Streptococcus hemolyticus* up to 1:32 and showed precipitins up to 1:8. Attempts were made to determine whether or not the *Streptococcus hemolyticus* pneumonia cases, some time in the disease, showed any antitoxic properties against this organism and some explanation of our sterile blood cultures in antemortem cases where localized infections (lungs, pleura, etc.), with general symptoms, were so evident. As

controls, a non-infected individual's blood was collected in citrate, used pure, diluted 1:2, 1:3 and up to 1:100 with dextrose broth. The amounts of blood or mixture in each tube were 1 c.c. Each of these tubes was contaminated with *Streptococcus hemolyticus* and incubated twenty-four hours, then subcultures were made. A normal individual's blood had no antitoxic properties in any dilution. All blood of patients tested having *Streptococcus hemolyticus pneumonia*, either before or after the crisis, showed at least inhibitive effect on the original contaminations in pure blood and in 1 to 2 dilution, not higher than this, in some cases not even subcultures were obtained in pure blood and 1 to 2 dilution showing some antitoxic or bactericidal effects of the blood of these patients. Some investigators have been getting positive *Streptococcus hemolyticus* blood cultures in a high percentage of their pneumonia cases, but only in the first ten to twenty-four hours or very late in the disease. The experience in the above experiments might possibly aid us in our explanation of negative blood cultures in these cases brought to this post comparatively late in the disease for a positive culture.

In testing for agglutinins and precipitins in pleural fluids agglutinins up to 1 to 320, precipitins, 1 to 10 were found. Several pleural fluids immediately after chest puncture showed a decided acidity as high as 1 degree to phenolphthalein, and readily turned blue litmus red. When inoculated into white mice and guinea-pigs the mice showed an immediate marked toxicity, which after four to six hours gradually subsided, while the guinea-pigs were only temporarily sick from this effect up to 5 c.c. of filtered pleural fluid having been administered. When roentgen rays and pleural punctures were frequently made there was noticed an early pleuritic effusion following the pneumonia, with a rapid spread in the amount of fluid (even when all other tissues at autopsy were very dry). At first this fluid was clear straw-colored. Cultures of it were sterile, then in twenty-four to forty-eight hours became definitely purulent, showing *Streptococcus hemolyticus*. When filtered blood serum was inoculated into white mice and guinea-pigs practically no toxic effects were noted in the guinea-pigs and only very slight effect on the mice as compared to the toxicity of pleural fluid. Virulent cultures from fatal cases of *Streptococcus hemolyticus* infections were used in our experiments. Heated at 55° C. for one hour, 500,000,000 organisms were given by a small needle into guinea-pigs intracardially, giving rise to slight temporary reactions for several hours. When these organisms were given with 10 per cent. sodium citrate no reactions of this type occurred in the few animals inoculated. Guinea-pigs were next inoculated with live *Streptococcus hemolyticus* cultures 0.5 c.c. intracardially. They all showed toxic reaction for some hours, which subsided, although mice inoculated intraperitoneally with same cultures died universally. The following methods were adopted subsequent to this in order to see what effect

exposure and lowered resistance had on our inoculation experiments. After inoculating 0.5 c.c. of virulent *Streptococcus hemolyticus* cultures intracardially into guinea-pigs they were put into our incubator, where water was kept steaming to moisten the air, for twenty to thirty minutes. The animals during this time showed marked polypnea and dyspnea, then were permitted to run about in the open cold air. Lobar and lobular pneumonia of the typical streptococcus type were produced, as manifested by inspection signs of pneumonia, confirmed by roentgen rays and autopsy. Two animals were permitted to recover so that roentgen-ray plates in the various stages of pneumonis could be obtained, one lobar and the other lobular. When these same organism cultures were incubated in 10 per cent. sodium citrate for twenty-four hours, then inoculated intracardially, the "devitalized" growth gave no reaction. Two guinea-pigs that were immunized against *Streptococcus hemolyticus* by giving vaccine when given the virulent cultures intracardially with "lowered resistance treatment" developed typical *Streptococcus hemolyticus* purulent pericarditis, one animal having as much as 8 c.c. of pus in its pericardium. When two of our guinea-pigs that had not been given lowered resistance treatment with their inoculations and showed only temporary reactions were subsequently given the same inoculation with lowered resistance treatment they developed pneumonia, as confirmed grossly at autopsy.

Streptococcus hemolyticus cultures sprayed on the pharynx of normal guinea-pigs, which was done on only a limited number of animals, showed no susceptibility of normal mucous membrane to the infection. In our sections of lungs from fatal cases, showing numerous streptococci all through the involved areas by Gram-staining, the tissue cells, and especially the alveolar epithelium, attacked or were attacked by the organisms. Many of the epithelial cells were engorged with streptococci either in good condition or in degenerated stages.

Pathological findings of 104 autopsies were summarized, showing a lobar or lobular pneumonia, or both, in one or more lobes and associated changes in various organs and tissues of the body.

Most of our cases were very good specimens of manhood. From their histories they were hearty meat eaters, although I do not know that this had any bearing upon the infection. In many cases petechiæ and fibrilulæ were found in the skin, and under serous and mucous membranes, petechial hemorrhages. Jaundice was noted in 24 per cent. of our cases, with no evidence of direct mechanical obstruction in ducts of the gall-bladder—evidently "hematogenous" jaundice. The general glandular and osseous systems showed nothing striking anywhere. There were slight parenchymatous changes in the muscular system. The various tissues, except where there was local *Streptococcus hemolyticus* infection, were extremely dry in very many of our early cases, although in the pleural cavities as much as 1500 c.c. of fluid were present. Parenchymatous changes

were noted to a greater or less degree in the majority of the organs examined—depending to a large extent upon the degree, severity and duration of the infection, etc.

Summary of pathological findings on 104 autopsies.

Lobar pneumonia.		Per cent.	
1 lobe	Right	3 cases (50 per cent.)	6 cases
	Left	3 cases (50 per cent.)	
2 lobes			14 cases
More than two lobes			61 cases
			81

Red hepatization about 70 to 80 per cent.

Gray hepatization about 20 to 30 per cent.

Gross gangrene or abscess of lung 9 cases, or 9 per cent.

Lobular or bronchopneumonia:

Right side	16
Left side	11
Both sides	13
Total	40

Lobar and lobular pneumonia occurred combined in 36 of these 40 cases. It would seem from these results that the etiological nomenclature would be preferable to the geographical since *Streptococcus hemolyticus* can be demonstrated in tissues, sections and cultures in a large percentage of these cases, and a good name for them would be *Streptococcus pneumonias* instead of lobar or lobular.

Pleurisy:		Per cent.	
Purulent	Left	14	26.4
	Right	31	58.5
	Both sides	8	15.1
	<i>Streptococcus hemolyticus</i>	53	75.7
	Type IV	3	4.3
	Sterile	14	20.0
Total fluids		70	
Adhesive	Right	5	
	Left	2	
	Both sides	3	
Total		10	
Fibrinous	Right	2	
	Left	5	
	Both sides	2	
Total		9	
Pericarditis	Acute plastic or early fibrinous	9	
	Adhesive	3	
	Purulent	7	
Total		19	

18.2 per cent. of all infections.

Chronic vegetative endocarditis in 4 cases.

Subcutaneous emphysema, 2 cases.

One had a lung puncture.

One perforative purulent peribronchitis (left).

Many of our pneumonia cases, both lobar and lobular looked like very large or very small pulmonary infarctions, hemorrhagic in type, the centers of which in the lobar pneumonias (in gray hepatization) were gangrenous or necrotic. On closer examination they had many of the smaller vessels occluded by thrombosis while the bronchi, except in some cases accompanying the vessels, did not seem completely occluded by plugs or masses of fibrinous or other material. All these things would tend to make one think that the infection, after a temporary bacteremia (from previous statements), entered the pulmonary circulation, was distributed and localized like hemorrhagic infarctions, in this way causing pneumonia. Further experimentation and investigation are necessary to clear up this matter, very important from many points of view, carriers, prophylaxis, pathology, etc., of these cases.

Further questions that came up in our cases were: "Did the lobar pneumonia begin as lobular or bronchopneumonia and later become lobar or were each of these types separate and localized in its division throughout the entire course of the disease and distinctive as such?" Finding both lungs entirely consolidated from apex to base, in forty-eight to seventy-two hours from the onset of the disease, and from other observations, were inclined to the latter statement.

Description of Lungs. Many of our lobar pneumonias showed in red hepatization stage a reddish-brown or very congested venous appearance, with numerous subpleural hemorrhages of variable sizes, scattered over large or small areas. The lungs were extremely dense and frequently in a very marked inspiratory state, in typical cases, having no crepitation anywhere, and sinking rapidly into water. On section the characteristic pneumococcus red hepatization was not present. The lungs were very congested and succulent, blood oozing out everywhere, giving a moist, smooth appearance, with no plugs of fibrin in the bronchioles, but often a liquid purulent material. Microscopically the alveoli and interstitial tissues were filled with erythrocytes in predominance everywhere, a few leukocytes and alveolar epithelia, with a relatively smaller proportion of fibrin than in pneumococcus pneumonias, suggesting the name "hemorrhagis pneumonitis." Many of the smaller vessels were thrombosed or engorged in addition to capillary engorgement. In a few cases a definite acute peribronchiolar inflammation was seen, a definite leukocytic layer around the bronchiole of varying width being seen microscopically.

In the gray hepatization stage the lungs looked reddish gray, grayish or yellowish gray; the affected tissues were less tense than in the red stage and somewhat softer, very friable; the cut surface was smooth and moist, showing an exudate of partly emulsified inflammatory tissues. Microscopically, many red cells were still found, with many alveolar epithelial cells; the predominating cells were leukocytes, very little fibrin, as in the red stage, having been present,

In older grayish lungs the cellular contents of the alveoli were granular and fatty showing marked degeneration and dissolution. Streptococci were found profusely in these sections also in blood-vessels in all stages, some of the alveolar epithelial cells having been engorged with them.

The involvement in some cases appeared like huge pulmonary infarctions, occupying a large portion of a lobe, grayish in the central part, reddish or congested about this portion, the very center abscess-like and extending wedge-shaped toward the hilum of the lung. Small and large abscesses were not very infrequent; smaller ones in the lobular as well as the lobar involvements.

The lobular pneumonia cases in some were similar to the usual types of bronchopneumonia, and in others were like pulmonary infarctions, except for the fact that they did not show the usual pictures of later pulmonary infarctions when the pneumonias were prolonged, tending more to become purulent or to go on to complete resolution. Others showed peribronchiolitis or purulent bronchitis. In nearly all cases the lungs were very congested. Often there were conglomerate or diffuse lobular pneumonias appearing almost like lobar pneumonias, but were not completely solidified as in the latter. Microscopically isolated fields would show almost the same pictures as seen in various stages of lobar pneumonia, except for a larger amount of alveolar epithelium, less fibrin and usually a great leukocyte content, with a fair amount of mucus and a few red cells.

The pleura was involved, as seen in our previous data, in a very large percentage of our cases, varying in the type and degree of involvement and depending on whether it was dry, plastic or simply roughened and hyperemic; whether there was a fibrinous deposit, with or without fluid; whether this fluid was definitely purulent and thick or thin and flaky, with many streptococci in it. The adhesive pleuritis was slight or marked in thickness and extent. In one of our cases there was a pulmonary abscess in the center of gray hepatization, which was surrounded by a localized purulent pleuritis, and the abscess had a communication with the bronchus. In another we had a pyopneumothorax, communication having been free between the pleura and bronchus. The layers of the abscesses consisted of centrally necrotic disintegrating lung tissue, surrounded by a layer of solidified lung, containing leukocytes and some young connective-tissue cells, around which in turn was a layer of edematous lung.

The heart, in addition to pericarditis in quite a few cases, showed frequently subpericardial hemorrhages of varying sizes, and almost universally a condition of extreme diastole of the right side, with some coronary and venous congestion.

In concluding, we call attention to the fact that the data written was meant chiefly as a summary of laboratory work as related to so-called influenza and pneumonia at this post, and no attempt has been made to review the entire epidemic or to give an exhaustive review of the subject.

THE INFLUENZA-PNEUMONIA EPIDEMIC AT CAMP DODGE, IOWA, 1918.

BY EDWARD T. EDGERLY, MAJOR, M.C., U.S.A.,
CHIEF OF MEDICAL SERVICE, OTTUMWA, IOWA,

FRANK M. MANSON, CAPTAIN, M.C., U.S.A.,
CHIEF OF SURGICAL SERVICE, WORTHINGTON, MINNESOTA,

WILLIAM G. DWINELL, MAJOR, M.C., U.S.A.,
CHIEF OF LABORATORY SERVICE, PROVIDENCE, RHODE ISLAND,

AND

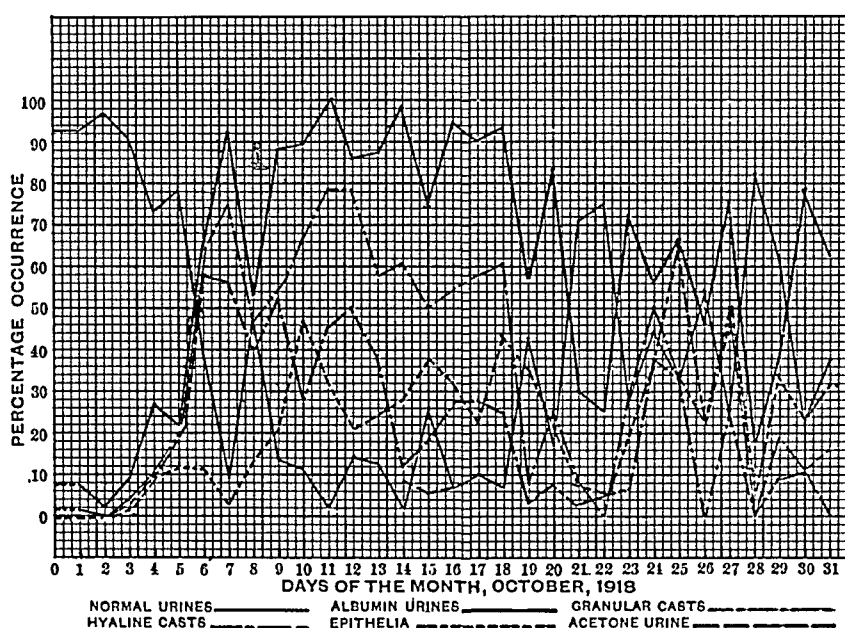
JAMES G. CARR, CAPTAIN, M.C., U.S.A.,
MEDICAL SUPERVISOR, CHICAGO, ILLINOIS.

So much has already been written and spoken on the manifestations of the recent pandemic, and there has been such marked agreement on the general features as shown by reports from the various cantonments and civil centers, that more than a cursory comment on those features would be superfluous. The coming and the going were startling in their suddenness; the numbers attacked were overwhelming; the ravages of the disease shown by the blue faces and labored breathing, and the deaths so sudden and numerous, that many exclaimed, "This is the plague!" The revelations of the tissue damage at the autopsy table were convincing that once the disease invaded the body to any depth, drugs could have but little effect.

Knowing the epidemic was ravaging other cantonments and civil communities, the medical officers of Camp Dodge were on the lookout for cases of the disease, isolating by cubicle all persons with respiratory infections and culturing particularly for the *Bacillus influenzae*. This did not appear to be of great value, as throat cultures of many patients previous to that time had shown that organism. The convincing proof that we were invaded came from the rapid increase of admissions. The hospital population had been running unusually low, around 1200, with a total daily admission rate of 40 to 50. The first reported influenzas were on September 22, 1918. The admissions ran up rapidly, 240, 411, etc., three days showing over 1000, the maximum being attained October 4, 1918 (1275), and fell as rapidly, so that on October 19 there were but 28. The maximum number of all classes of disease (all other classes being cut to minimum, possibly 300 to 400) occupying beds on one day was 8000 on October 8. The total deaths to November 1 was 702. The highest death-rate (82) occurred on October 12.

The bedding of the hospital normally, according to the number designated per ward, which varied from time to time, was 2000 to

2200. By the use of corridors and porches this was expanded to nearly 3000 and the taking over of 60 barracks, "Y" and "K. C." buildings and officer's quarters, enabled us to care for the balance of the patients, some sixty extra medical officers and between 300 and 400 volunteer nurses. The emptying, cleaning and equipping of these buildings, the care of the immense number of sick, the establishing and maintaining of numerous messes and a substation medical supply depot was an immense physical task, the performance of which reflects great credit on the commanding officer and on those in authority over us and on the Quartermaster's Department, Red Cross and other volunteer agencies.



The unflinching devotion of those of all ranks in attendance on the sick and the uncomplaining conduct of those afflicted were inspiring.

The plan of subdividing responsibility was followed by appointing supervisors of sectors of wards and barracks. Those who came to us gave invaluable aid, among them, Colonel Jennings, of Brooklyn, Majors Dare and Codman, of Philadelphia, who were mobilizing units in the camp. Daily meetings of a "pneumonia board" were held to discuss the situation and frequent talks given the medical officers as well as issuing of bulletins to instruct medical officers.

Some 25 medical officers were stricken but none died. Over 150 nurses broke down and 8 died. About 20 of the Base Hospital enlisted personnel died. It was noted that practically none of either of these classes who went through the epidemic last spring, whether ill then or not, were sickened. Not a man in the receiving ward, all old men, though breathing the air of rooms through which the

thousands passed, was taken ill. On the other hand, a regiment coming from Alaska furnished the largest mortality. These facts would suggest an acquired immunity by contact and gives hope that methods of establishing an artificial immunity may be found.

The registrar's figures show that from September 16 to December 15 inclusive 10,041 cases of influenza were admitted and diagnosed. The camp epidemiologist reported 1000 cases treated in infirmaries; 2081 cases of pneumonia followed, of which 747 died, making a mortality of 35.8 per cent. of pneumonias, or considering the total number of cases of influenza in camp as 11,000, the mortality of the epidemic 6.8 per cent. It is believed that many cases of pneumonia went undiagnosed during the rush. In 300 charts of cases discharged as influenza only, a study revealed evidence given by the charts themselves that 24 of them were really pneumonia; if this proportion would hold out in the 9000 cases this would mean 720 cases and bring the total up to 2800, with a corresponding lowering of the mortality rate of pneumonia to 26.6 per cent. The average monthly strength of the camp for October, the period of intensity of the epidemic was 32,956 and the deaths 700, causing a camp mortality of 2.12 per cent. The white and colored troops numbered practically 29,000 and 4000 respectively and the morbidity and mortality were almost identic.

Incidence of fluid in the chest: In the 122 autopsies, 70 cases had pus in the chest, 24 more had infected serum and practically all had some fluid. This proportion if carried out in fatal cases not autopsied added to the diagnosed and operated cases plus a probable considerable number undiagnosed, but apparently recovered, would give a very high incidence of fluid in chest. The diagnosis is unusually difficult. The pathologist's report of finding large areas of edema around smaller patches of infected lung would explain some of the changes in physical findings from day to day, the findings due to edema changing rapidly.

The presence of rales in so many influenza cases and the low blood count in both influenza and many uncomplicated pneumonia cases raises the question whether influenza and pneumonia are not both due to the influenza bacillus or to some unknown organism, and whether the secondary invaders, in this camp chiefly the *Streptococcus hemolyticus*, are responsible for pus formation only.

Together with other laboratory work on account of stress, urinalysis had to suffer, but the accompanying chart shows the marked increase in cases showing albumin and casts during the height of the epidemic, agreeing with the constant postmortem findings of nephritis.

The investigations of Lieut. Seham, camp epidemiologist, seem to show that several individuals and organizations may have carried the disease into camp: in particular members of an ambulance company, who had driven ambulances to Chicago, remained there

a day or so, where the disease was active, and then returned, some were taken ill on the train and others later, these being among the first admitted to the hospital.

TREATMENT. Each supervisor was authorized to direct the treatment in his sector. As a rule the medical treatment of the simple influenza cases consisted of elimination, rest, use of aspirin or salicylates and alkalies; gargles were used and many throats painted with nitrate of silver solution. The routine treatment in this hospital for pneumonia had been the use of digitalis and opiates as required and more active stimulation if indicated.

Four different substances were administered by the intravenous method.

1. Glucose: A 2.5 per cent. solution of Merck's purified glucose in distilled water was made; this was filtered and 200 c.c. placed in each of the desired number of Erlenmeyer flasks; autoclaved for fifteen minutes at 15 pounds' pressure; cooled to 40° C., when 10 c.c. of a 30 per cent. aqueous solution of sodium bicarbonate was added; above 40° C. the soda is disassociated. Dose, 180 to 250 c.c.

1140 injections were given to 475 men, of whom 97, or 20 per cent., died. So many desperate cases showed marked improvement that many ward surgeons, though not all, approved the treatment. Most cases showed a sharp reaction with a chill, and this seemed to be a favorable sign.

2. Formaldehyde solution: 7 minims of formalin were added to 100 c.c., quantities of physiological salt solution and sterilized in Erlenmeyer flasks. Dose, 80 to 100 c.c.

595 injections were given to 243 men, 22 per cent. died.

3. Peptone solution: A 10 per cent. solution of commercial peptone in distilled water was prepared; autoclaved and filtered three or four times to give clearness; put in Erlenmeyer flasks, placed in Arnold sterilizer for twenty minutes. Dose, 8 to 10 c.c.

590 injections were given to 243 men, of whom 20 per cent. died.

Of these three methods the last commends itself by reason of its simplicity. It did not give as marked a reaction as the other two, but showed a rise of temperature. Naturally the query arises in view of the fact that, statistically, the cases treated by all three of these different substances, all given intravenously, and to a great majority of cases of the grave type, showed a mortality less than the average of the epidemic, and that a reaction occurred, in some cases, alarming for a short time whether the beneficial action was obtained by arousing the protective forces of the body; a very limited number of cases studied by blood counts before and after the injections, seemed to show that a leukocytosis was produced.

4. Convalescent Serum: Convalescent patients were bled, the clot allowed to form, the serum pipetted off, a Wassermann test made, cultures taken, the serum inactivated at 56° C. and the recipient's compatibility tested. Dose, 30 to 70 c.c.

This method was used at first on desperate cases only and, judging by them, the results were not encouraging. In a series of 14 cases in which the serum was given as soon as practicable after the diagnosis of influenza-pneumonia was made but one died and the courses of the others were short.

The fact that many apparently desperate cases under symptomatic or digitalis therapy had crises or sudden changes for the better made it difficult to properly value the intravenous methods.

Vaccines: The army influenza vaccine had not reached us at the time of the epidemic. Sherman's No. 38 mixed vaccine was used in the treatment of a limited number of cases and was believed by Major Arthur Dare, who directed its use, to be of benefit. A similar mixed commercial vaccine was used on several hundred influenza cases in the hope of preventing the pneumonia sequel, but the burden of work prevented careful statistical study, and the consensus of opinion was that no demonstrable benefit resulted.

It is agreed by all that absolute rest in bed, fresh air, plentiful use of water and nourishing, simple diet are the essentials of treatment. Those on porches did better than those in wards; patients who had been on porches and moved in asked to be taken out again. Great caution should be used in letting patients up or undertaking work, as myocardial weakness often results. It was deemed wise to hold the patients in the hospital until the blood count fell to 10,000, as higher counts had indicated pus in some cases, which it was not possible to diagnose until a considerable time had elapsed.

Our judgment, based on our experience, is that the problem for the future is the discovery of some agent, along serum or vaccine lines, for the treatment and more particularly the prevention of the infection. Preceding this the offending organism must be identified definitely, as we believe now is not the case.

LABORATORY REPORT ON EPIDEMIC PNEUMONIA,

CAMP DODGE, IOWA.

BY WILLIAM G. DWINELL, MAJOR, M.C., U.S.A.,

PROVIDENCE, RHODE ISLAND.

DURING the week preceding the sudden appearance of the epidemic of September 28, 1918, three distinct outbreaks of an infectious nature occurred in widely separated sections of the Base Hospital at Camp Dodge. Pharyngeal cultures from these cases showed *Streptococcus hemolyticus* and *Bacillus influenzae* present in unusually large numbers. Admissions during this period increased moderately in number and an unmistakable but not alarming number of acute nasorespiratory disturbances, not unlike similar clinical conditions of the preceding month, gave warning of impending trouble.

UNCOMPLICATED INFLUENZA.

September 29, 1918, laboratory workers detailed to the admitting office, cultured and made white blood counts on 152 cases. It was found that the *Bacillus influenzae* was present in 66 per cent., *Streptococcus hemolyticus* in 45 per cent. and the *M. catarrhalis* in 71 per cent. of the cultures and that the average count was 9300.

Clinical notes on the 152 cases taken on admission to the hospital showed the following:

Onset . . .	Gradual, 72	Headache	101
	Sudden, 38	Cough	61
Tonsil irritation	Severe, 27	Epistaxis	14
	Moderate, 45	Pharyngitis	40
Chest rales	67	Conjunctivitis	56
Photophobia	55	Apathy	13

Further observation of these cases established the average duration of temperature at four days; the average stay in the hospital at nine and one-tenth days and the 890 white blood counts ranged as follows per day:

First day	9300	Fifth day	7200
Second day	8000	Sixth day	7700
Third day	8200	Seventh day	8200
Fourth day	6000	Eighth day	8200

REPORT ON 53 INFLUENZA PNEUMONIA AUTOPSIES.

Between October 3 and October 11, 53 complete autopsies were performed. The following data has been compiled from the records on the first 53 cases of epidemic pneumonia autopsied by Captain Arthur S. Brumbaugh, M.C.

A purplish mottling of face, neck and dependent portions was present in nearly all cases dying within two weeks of onset. The gross pathological lung lesions divide the findings into three classes or types of pneumonia: (1) The broncho-interstitial type, which showed small interstitial hemorrhagic areas about moderately thickened bronchi of varying size, standing out prominently from the sectioned surface and exuding dark red blood. (2) the lobular type, in which hemorrhagic areas of infiltration of varying sizes, without noticeable bronchial thickening, were encountered. Both types were not unlike the conditions found and described by Dr. MacCallum during the pneumonia epidemic of May, 1918. Several cases were found having in one lobe lesions characteristic of the broncho-interstitial type, while the adjoining lobe revealed a picture of the lobular form. To this unusual condition the term mixed or broncho-lobular pneumonia was given. This nomenclature, while describing accurately many of the lung lesions grossly, should not be relied upon too implicitly, as further histological study may place a much larger number of cases in the mixed or broncholobular class.

The following table shows the number and percentages of the

various types of pneumonia and empyema found at autopsy of 53 cases:

Pneumonias:		Per cent.
Broncho-interstitial	23	43
Lobular	18	34
Mixed	10	19
Lobar	2	4
	<hr/> 53	<hr/> 100
Empyemas:		
Bilateral	7	31
Right	5	26
Left	10	43
	<hr/> 22	<hr/> 100
Infected serosanguineous pleuritis:		
Lobular	12	63
Broncho-interstitial	4	21
Mixed	3	16
	<hr/> 19	<hr/> 100

Of the 31 cases dying without empyema, 29 died within two weeks of onset of the first symptoms, the average duration being seven days; the extremes were three to thirteen days. The 2 dying later than fourteen days died at fifteen and forty-four days respectively from the date of onset.

Because of the uncertainty attending the onset of the pneumonia the duration of the disease in all cases was figured from date of onset of first symptoms of illness.

COMPLICATIONS OF 53 CASES.

Process.	Number.	Average duration, days.	Complicated by empyema.
Parenchymatous degeneration of kidneys	53		
Splenic tumor	29		
Acute adrenalitis	28		
Mediastinitis	19	13.5	14
Pericarditis	9	11.8	4
Peritonitis	6	22.0	2
Septal thickening	10	16.9	7
Bronchial thickening	6	15.0	1
Necrosis of lung	4	14.0	3
Acute myocarditis	4	6.5	1

Following is a summary of the organisms found in the 53 autopsies:

The *Streptococcus hemolyticus* was recovered in 80.7 per cent. of the cases from either the lung, pleural cavity or from the heart's blood, and from the latter source in 52 per cent. of the cultures. The *Bacillus influenzae* was recovered in 5 cases, or 9.6 per cent. of the cultures, and was found in 3 cases in both the lungs and pleural cavities, in the heart's blood once and in the peritoneal cavity once. The *Bacillus influenzae* was found associated with the *Streptococcus hemolyticus* four times and the *Staphylococcus aureus* once. A non-hemolytic streptococcus was recovered five times and the *Staphylococcus aureus* twice.

The low incidence of *Bacillus influenzae* found was undoubtedly due to poor technic in handling the cultures. The large number of positive cultures obtained from the 69 cases of the second series may be ascribed to several factors: first, excision of lung tissue and direct smearing of freshly made human blood-agar plates adapted to influenza work at a reaction of 0.2 acid of phenolphthalein and containing two drops of blood to 200 c.c. of glucose agar, meat infusion. This medium, prepared under the direction of Lieut. C. G. Dennett, gave more positive cultures than the laked rabbit blood previously used.

It should be noted that the cultures reported as *Bacillus influenzae* did not grow as typical dewdrop colonies as described by Pfeiffer and others. The colonies were less definitely outlined, slightly granular in the center, suggesting a faint opaquish color. There was no growth on plain agar. The bacilli varied in size from a coccus bacillus to a rod of slightly larger than the typical Pfeiffer bacillus in the original culture. Mannite, sucrose and lactose were not fermented. One cubic centimeter of moderately heavy emulsion was not lethal to either mice or guinea-pigs.

By order of the division surgeon all postmortem examinations were discontinued October 11, 1918. At this time the large number, over 1500, desperately sick men and the exceedingly high daily death-rate urgently bespoke what aid the laboratory might give during the emergency. To this end convalescent serum and solutions of glucose, formalin and peptone were prepared in considerable quantities for intravenous use.

REPORT ON 69 INFLUENZA PNEUMONIA AUTOPSIES.

From October 23, 1918, when permission was received to resume the postmortem work, to December 1, 1918, 69 necropsies were made on cases dying from epidemic pneumonia or from the septic processes following it. The following table shows the postmortem findings:

Pneumonias:		Per cent.
Broncho-interstitial	26	37.6
Lobular	27	39.2
Mixed	14	21.7
Lobar	2	2.9
	69	100.0
Empyemas:		
Bilateral	21	43.7
Right	19	39.6
Left	8	16.7
	48	100.0
Infected serosanguineous pleuritis:		
Bilateral	0	0.0
Right	2	66.7
Left	1	33.3
	3	100.0

Of the 21 cases dying without empyema, 11 died within two weeks from the onset of the first symptoms, the average duration being seven days; the extremes being one to twelve days; the 10 dying later than fourteen days averaged twenty-four days; extremes fifteen to fifty-four days. Eleven of the 48 empyema cases lived an average of eleven days, extremes five to fourteen days. The remaining 37 cases averaged thirty-two days; extremes seventeen to seventy-two days.

The following table shows the complications that occurred in 69 cases:

Acute nephritis	67
Acute adrenalitis	45
Acute splenic tumor	39
Pericarditis	20
Mediastinitis	19
Septal thickening	18
Necrosis of lung	17
Pleural pockets of pus	17
Bronchial thickening	8
Myocarditis	8
Peritonitis	6
Interlobular pockets of pus	11

Bacteriology of 69 cases:

Organism.	Number of cases.	Per cent.
Hemolytic streptococcus	41	59.4
Bacillus influenzae	34	49.3
Non-hemolytic streptococcus	17	24.6
Hemolytic staphylococcus	13	18.9
Type I pneumococcus	1	1.5
Type II pneumococcus	2	2.9
Type III pneumococcus	4	5.8
Type IV pneumococcus	1	1.5

REPORT ON 122 INFLUENZA-PNEUMONIA AUTOPSIES WITH COMPLICATIONS.

Table "A," showing the types of pneumonia in 122 cases:

	Broncho-interstitial.	Lobular.	Mixed.	Lobar.
69	26	27	14	2
53	23	18	10	2
<hr/> 122	<hr/> 49	<hr/> 45	<hr/> 24	<hr/> 4

Table "B," showing the types of pneumonia associated with empyema.

	Broncho-interstitial.	Lobular.	Mixed.	Lobar.
69	21	17	7	2
53	16	4	3	1
<hr/> 122	<hr/> 36	<hr/> 21	<hr/> 10	<hr/> 3
				Total, 70.

Table "C," showing the duration of disease in 52 out of 122 cases dying without empyema:

37 died within 14 days	Average, 7 days	Extremes, 1 to 13 days.
15 died in 15 days or later	Average, 25 days	Extremes, 14 to 72 days.
24 of the 37 cases had infected seropleuritis.		

Table "D," showing type of pneumonia with five lobes involved in 37 cases dying within fourteen days without empyema.

	Cases.	Number with five lobes.
Lobular	22	15
Broncho-interstitial	8	7
Mixed	7	6
	<hr/> 37	<hr/> 28

Table "E," showing 15 cases dying over fourteen days without empyema and their complications; 122 cases.

	Cases.
Lobular	3
Broncho-interstitial	5
Mixed	6
Lobar	1
	<hr/> 15

Complications:

- 4 died on sixteenth day uncomplicated with pus processes.
- 1 died on fifty-fourth day with pericarditis and peritonitis.
- 1 died on nineteenth day with lung abscesses, psoas abscess, purulent nephritis and peritonitis.
- 1 died on fifteenth day with acute myocarditis.
- 1 died on twenty-eighth day with lung necrosis.
- 1 died on twenty-fourth day with septal pockets of pus, lung abscesses, hepatic abscess.
- 1 died on fifty-fourth day with lung necrosis.
- 1 died on thirty-fourth day with multiple subcutaneous abscesses.
- 1 died on fifteenth day with acute muco-enteritis.
- 1 died on twenty-third day with myocarditis and leptomeningitis.
- 1 died on eighteenth day with lung abscesses.
- 1 died on twenty-third day with purulent pericarditis.

15 Total.

Table "F," showing type of pneumonia in 31 out of 122 cases with empyema dying fourteen days and less and number with five lobes involved.

	Cases.	Number with five lobes.
Lobular	11	8
Broncho-interstitial	16	5
Mixed	4	2
	<hr/> 31	<hr/> 15

Table "G," showing type of pneumonia, all cases, dying in less than fourteen days; 122 cases.

	Cases.	Number with five lobes.
Lobular	33	23
Broncho-interstitial	24	12
Mixed	11	8
	<hr/> 68	<hr/> 43

Table "H," shows all complications in 122 cases. All cases had acute tracheitis and bronchitis, varying in severity from moderate to hemorrhagic, resulting in one case in a tracheal ulcer. All cases showed enlarged bronchotracheal lymph nodes.

	Cases.
Parenchymatous degeneration of kidneys	110
Acute adrenalitis	73
Acute splenic tumor	68
Pericarditis	29
Mediastinitis	38
Peritonitis	12
Septal thickening, average twenty days, extremes six to fifty-nine days	22
Peribronchial thickening, average twenty days, extremes eight to fifty-nine days	13
Lung necrosis, average twenty-two days, extremes six to fifty-five days.	16
Myocarditis	12
Lung abscess, average twenty-one days, extremes six to fifty-three days	11
Pleural pus pockets	17
Interlobar pus pockets	11
Tubercular bronchopulmonary lymphadenitis, or 10.6 per cent. . . .	13
Tuberculosis of lungs	8
Adrenal hematoma, one lived four days, the other seventy-two days	2
Arthritis and multiple skin abscesses lived an average of twenty-two days	4
Acute duodenitis, lived ten days.	
Acute enteritis, lived seven days.	
Meningitis, one pneumococcus Type IV and one pneumococcus Type I	2
Infarcts of kidneys	2

Two cases with esophageal ulcer lived an average of six days; 1 case with edema of the glottis lived sixteen days.

Two cases with vegetative endocarditis. One a meningitis pneumococcus, Type IV, died on the twenty-fourth day of the disease and four days after symptoms of meningitis appeared, showed at autopsy: leptomeningitis, left empyema, broncho-interstitial pneumonia, acute vegetative endocarditis and infarcts of the kidney. Staphylococcus aureus and bacillus influenzae were found in cultures from heart's blood and pleural fluid. The second case, 367, had a lobar pneumonia, and the autopsy findings may be found under that heading.

MEDIASTINITIS.

This complication occurred 38 times, or in about 31 per cent. of the 122 cases, was associated 32 times with empyema and in about 50 per cent. of the cases it occurred before the fourteenth day; the average being twenty-seven days, with extremes of four to seventy-

two days. Moderate widening of the mediastinal space with crepitation occurred with the mild cases; the more severe disturbances resulted in small pus pockets in either the anterior or posterior mediastinal spaces. The 3 cases showing general subcutaneous emphysema of the face and neck to Poupart's ligament were associated with mediastinitis and took their origin probably from a pulmonary interstitial emphysema. The alveolar air escaping into the interstitial tissue between the alveoli, because of increased alveolar pressure due to violent coughing, extended to the base of the lung and by this path eventually reached the subcutaneous tissue of the neck and trunk.

PERICARDITIS.

Cases.	Number.	With empyema.	With mediastinitis.
69	20	18	13
53	9	4	2
<hr/> 122	<hr/> 29	<hr/> 22	<hr/> 15

Twelve, or 41 per cent., occurred in fourteen days or less, the earliest being four days. Seventeen, or 59 per cent., occurred after fourteen days and averaged thirty-five days.

Pericarditis was found from the fourth to the fifty-ninth day of the disease. This complication probably resulted from infection by continuity and in most cases was associated with other pus processes, such as empyema and mediastinitis. The cases occurring late often had 400 to 500 c.c. of pus, with fibrin and marked thickening of the pericardium. The earlier cases showed roughening of the pericardium, with punctate hemorrhagic areas.

PERITONITIS.

The 12 cases with peritonitis averaged seventeen days, with extremes of six to fifty-four days. Of the 12 cases which lived an average of seventeen days, 3 occurred with empyema bilateral; 3 with empyema right, 3 with empyema left and 1 with a lung abscess and perinephritis and 2 were associated with operative procedures.

TUBERCULOSIS.

Fourteen cases, or 11.4 per cent. of the cases, showed evidence of tuberculosis. Of this number, thirteen, or 10.6 per cent., had bronchopulmonary lymphadenitis, and eight, or 6.5 per cent., pulmonary lesions which occurred in both lungs in 4 cases. There were four tuberculous abscesses and one miliary case, with foci in the liver and spleen.

LOBAR PNEUMONIA.

There were 4 cases at autopsy showing the lobar types of consolidation. Case 317, sick eight days, showed at autopsy: lobar pneumonia of the left lower lobe, left upper lobe and all lobes on the right side showed consolidation of the lobular type. There was an infected serosanguineous pleuritis bilateral and a hematoma of the right rectus muscle. Pleural fluid showed a hemolytic streptococcus and the lung puncture a non-hemolytic streptococcus.

Case 287, sick forty-three days, entered the hospital late in August, gave rise to great difficulty in differential diagnosis from typhoid, malaria and tuberculosis. Patient died October 8, 1918; and showed at autopsy a partially resolved lobar pneumonia, left, both lobes; interstitial bronchopneumonia, right, all lobes; empyema, purulent obliterative pericarditis and peritonitis. Hemolytic streptococcus was found in the pleural fluid and peritoneum.

Case 340, sick twenty-six days with a continuous temperature, showed at autopsy: Lobar pneumonia, left, both lobes; acute serous pericarditis; acute purulent mediastinitis and bilateral empyema. Heart's blood, left pleural fluid and right lung, showed pneumococcus Type IV. The left lung showed hemolytic streptococcus and the right lung *Bacillus influenzae*.

Case 367, sick thirty-six days, developed symptoms of meningitis on the thirty-fourth day after onset. Type I pneumococcus was isolated from the spinal fluid. Case showed at autopsy: purulent tracheitis and bronchitis, lobar pneumonia, right lower lobe; solitary tubercle, left upper lobe; vegetative endocarditis tricuspid and mitral valves; septic infarcts of left kidney; purulent leptomeningitis; hemorrhagic infarcts of the lung, empyema and localized pleural abscess, right. Heart's blood, pleural fluid and lung cultures showed pneumococcus Type I. Right lung showed non-hemolytic streptococcus and *Bacillus influenzae*. Sputum showed *Bacillus influenzae*, Type IV pneumococcus, hemolytic streptococcus and non-hemolytic streptococcus.

The bacteriological findings, the multiple septic foci and the duration of the disease in 3 of the 4 cases strongly suggests extensive lobular consolidation rather than a true lobar form. Case 367 strongly points to the pneumococcus as a possible tertiary invader.

CAUSE OF PNEUMONIA.

The influenza-like infection rapidly passes from the nasopharyngeal portal to the trachea and medium-sized bronchi, at which point the disease may entirely cease, completing the picture of uncomplicated influenza. Further rapid extension downward through the finer bronchial tree to the bronchioles, infundibuli and alveoli, an invasion of the pneumonic field, result in those cases

recovering in three or four days. In localized areas of bloody serous exudate into the alveolar spaces the tissues escape marked injury and further bacterial invasion with the secondary bacterial flora does not occur.

But those more seriously ill and in those cases ending fatally from either the influenzal virus alone or from the secondary septic process the alveolar walls sustain a more intense injury, and in addition to the bloody serous exudate the alveolar walls are found markedly thickened, portions of them staining lightly or not at all with hematoxylin, suggesting areas of necrosis.

Upon this damaged area the secondary invaders find a fertile field to propagate rapidly and produce intrapulmonary areas of consolidation and interlobular infiltrations and by extension through the lymph channels to the pleural surfaces produce the extrapulmonary lesions, empyema and mediastinitis.

NOTES ON 108 PNEUMONIAS ENDING IN RECOVERY.

The temperature curves of the 108 cases reported in Charts I, II and III were so irregular in character that it was found impossible to give an adequate picture without building a composite chart showing highest daily elevation based on the day of onset of the first symptoms and then inserting along the base line of each chart a curve showing the number of cases having a normal temperature by day of disease. To illustrate: Case 344 on the third, fourth, sixth and ninth days had a normal temperature; died on the twentieth day with peritonitis, empyema and broncho-interstitial pneumonia, both lower lobes resolving; with hemolytic streptococcus and *Bacillus influenza* in the lung. This case also illustrates the interesting fact that pneumonia may develop insidiously with pulse curve at 80, respiration 18, temperature as noted above and partially resolve, the secondary invader causing death on the twentieth day.

Chart I shows temperature curve, pulse curve, blood-count curve and days of normal temperature curve of the 15 cases out of 108 cases of pneumonia which reached a normal temperature by the eleventh day—the blood counts averaging between 7000 and 9000. This is probably typical of those pneumonias uncomplicated with beginning sepsis.

Chart II illustrates curves in which a normal level was reached by the nineteenth day. Note that between the sixth and the twenty-first days the white-blood count remains between 10,000 and 15,000, which when correlated with the slightly prolonged temperature curves may be interpreted as meaning moderate sepsis.

Chart III, with 78 cases returning to duty, shows a continual febrile period of forty-five days, of which thirty-five days are indicative of sepsis.

Table "E," page 221, suggests the possible foci of infection, as peribronchial, septal, mediastinal, lung abscesses, interlobular spaces, pleura, etc.

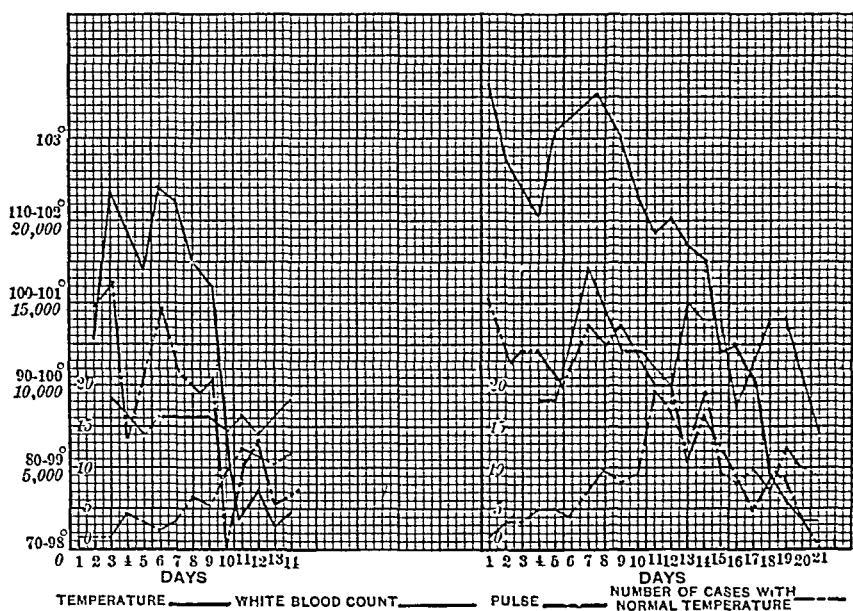


CHART I

CHART II

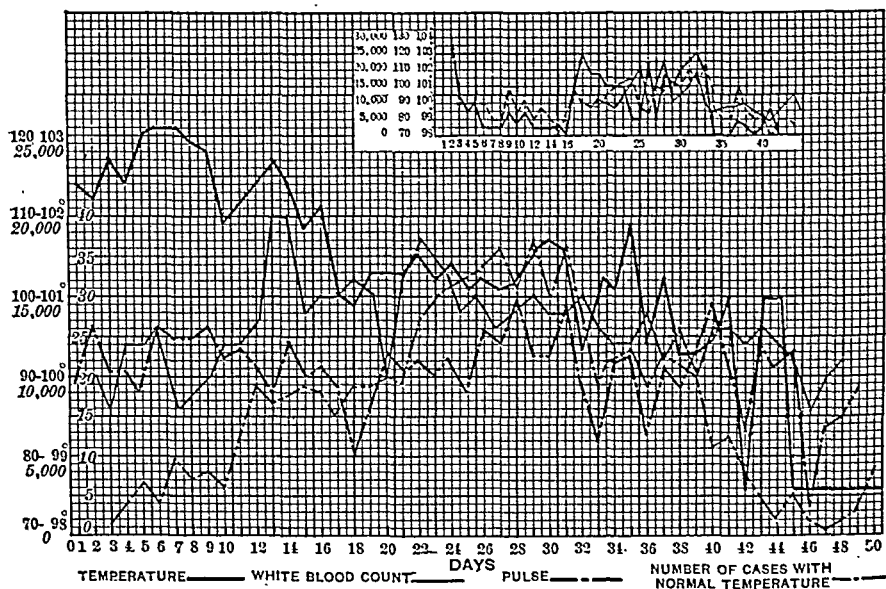


CHART III

If Chart I is accepted as typical of the uncomplicated pneumonic stage, Charts II and III clearly point to the beginning of

septic foci in some cases as early as the third day of the disease, and in this chart as well as in Charts IV and V, numerous cases on careful analysis show the septic process starting during the primary pneumonic stage. From this time to the sixteenth to the twentieth days, and in some cases at a still later date, sudden elevation of white counts and temperature showed the eruption of a focus of infection previously quiescent for days. This composite chart is misleading, in that it features the continuous elevation which is by no means the case. The first convalescent case studied had twenty-two days of elevated temperature and twenty days of normal temperature during his sickness of forty-two days, which is shown in Chart III.

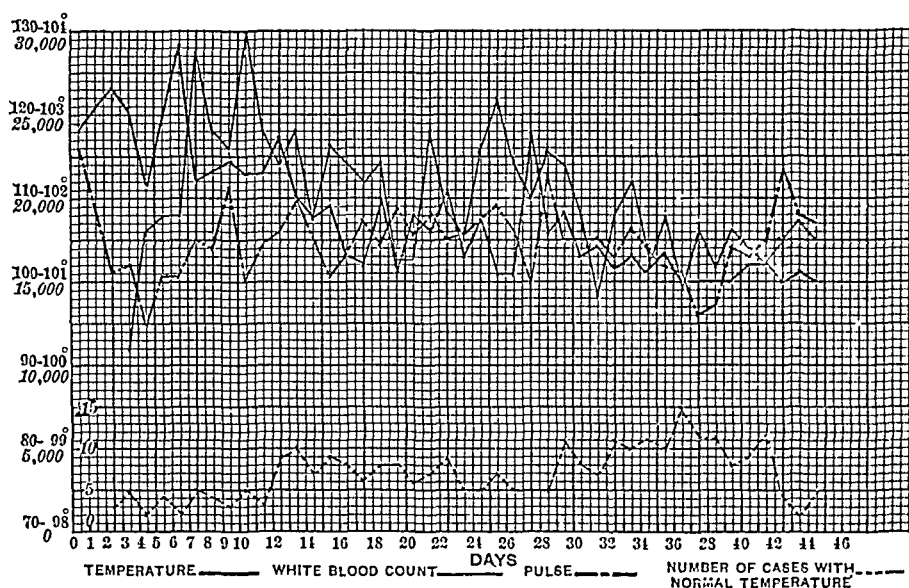


CHART IV

Chart IV graphically pictures beginning sepsis on the fifth day in forty-one empyema cases returning to duty. A study of this chart and autopsy tables permits the following deductions: Empyema may occur on any day of the disease. Of the 48 empyemas coming to autopsy in the second series of 69 cases, 20 were diagnosed ante-mortem from the eleventh day of the disease to the twenty-ninth day, the average being the twentieth day and the average number of days of life after the diagnosis was made was eleven; extremes one to twenty-eight days.

The broncho-interstitial type of pneumonia was more frequently associated with empyema than the lobular type.

Table "B," page 220, shows that in 70 cases of empyema the broncho-interstitial pneumonia occurred thirty-six times, the lobular twenty-one, the mixed ten and the lobar three times.

Case 326 is interesting as showing how a small area of lobular pneumonia, 6 cm. by 5 cm., indirectly caused death. Private M.,

admitted on the first day of the disease, had a temperature of 102° , pulse 102; had a normal temperature on the fourth and fifth days and died on the thirteenth day, after having had a continuous temperature for six days from empyema. Autopsy showed a small area of lobular consolidation in the right upper lobe directly below the pleura and 2500 c.c. of pus in the right pleural cavity.

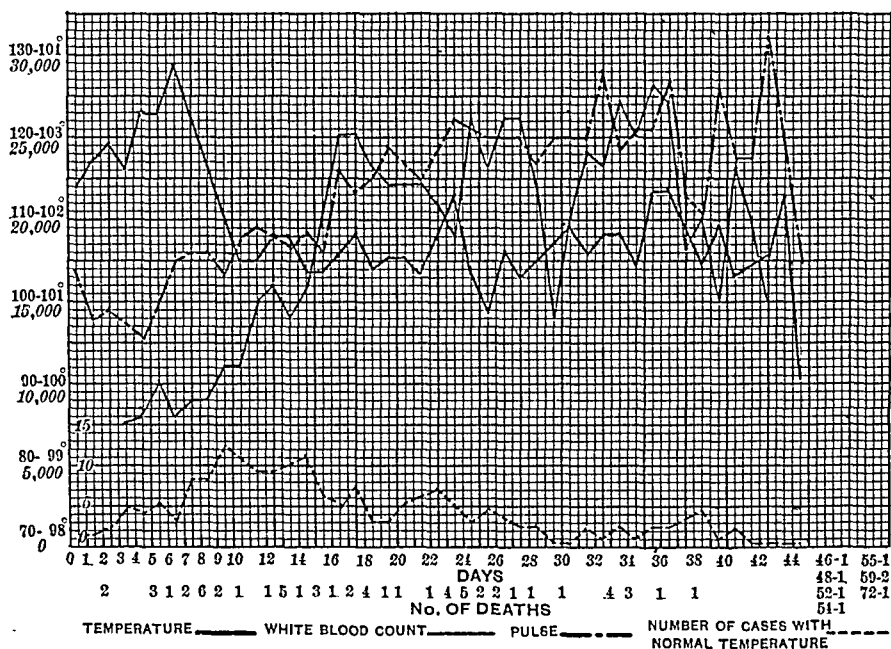


CHART V

Chart V, of 79 cases ending fatally, points to the early rise in pulse-rate to above 100 by the sixth day and its further elevation to 110 by the sixteenth day, and so on. The curve showing the number of cases with normal temperature is of particular interest in this chart from the tenth to fifteenth days, indicating that there was an average of 10 cases with a normal temperature lasting five days.

REPORT ON 3600 BLOOD COUNTS.

During the influenza and pneumonia period the white blood counts averaged low, 7000 to 9000 in those cases uncomplicated with beginning sepsis, indicating that the organism causing the infection belongs to the group of organisms not producing a leukocytosis. In the 108 pneumonia cases, Charts I, II and III, a leukopenia of 5000 to 6000 was found in 18 cases, with a continued temperature of more than fifteen days, which is interpreted as meaning that the secondary invaders were not active enough to produce either a leukocytosis or marked systemic symptoms in these cases.

All empyemas were associated with a leukocytosis; cases dying on the seventh to eighth day frequently showed a low count until

twenty-four hours before death, then a sudden elevation to 15,000 to 25,000 occurred.

Numerous counts showing sudden changes from 10,000 to 30,000 to 60,000 were noted and were attributed to the rapid accumulation of pus, usually an empyema or to a small pocket of pus, either intrapulmonary or extrapulmonary, under tension. Counts of 15,000 to 30,000 found during the septic stage, indicated sepsis and were found to be compatible with recovery without empyema.

Case No. 14; following an influenzal pneumonia the temperature was normal on the twelfth and thirteenth days, followed by an irregular, moderately high temperature for three months, was diagnosed empyema on the thirty-fourth day. Counts ranged from 37,000 to 65,000 during a ten-day period and on one occasion a change of 30,000 occurred in twenty-four hours.

Case 45 died on the fifty-first day of illness from pericarditis, mediastinal abscess and empyema. Counts from the twenty-first to the thirty-first day ranged from 26,000 to 75,000, with one twenty-four hour change of 24,000.

So insidious was the septic process in some cases that the period at which the patient might be safely discharged from the hospital became very uncertain. For this reason patients with counts over 10,000 remained under observation. The first 100 cases, when clinically ready for discharge, showed 41 with blood counts between 5000 and 10,000. Forty-five had counts ranging between 11,000 and 15,000, and 14 were counted over 15,000, the highest being 21,000.

Case 162, following a mild pneumonia, had a normal temperature on the twenty-fifth day which continued normal to the fifty-first day, the day of his discharge from the hospital, the counts being 22,400 to 12,000. The blood count on the day of discharge was 12,400. Patient was readmitted ten days later, and seven days after date of admittance died with a serofibrinous pericarditis; loculated pus pocket, left pleural cavity; mediastinitis and hematoma of adrenal.

Cases of chronic sepsis developing after a mild influenzal infection were suspected on several occasions of being malaria, typhoid or tuberculosis, because of the irregular temperature elevation occurring at three- and five-day intervals, lasting two or three days. In these cases the leukocyte count showed 10,000 to 15,000, indicating a septic focus, which in 2 cases was found at autopsy and in one with the roentgen ray. Sufficient evidence was found to place the semi-quiescent intra- or extrapulmonary pus foci following influenzal infections in the group of focal infections.

CAUSE OF DEATH.

Pneumonia: Sepsis. Analysis of the tables on pages 4 and 5 shows that of the 37 cases dying without empyema in fourteen days

or less 28 had five lobes involved and 22 of the 37 cases were of the lobular type. On adding to this number the 7 cases of mixed type with extensive lobular involvement the result, 29 with the lobular type, points to the lobular form as the most fatal, being present in 80 per cent. of the cases dying without empyema within fourteen days.

In the 31 cases of empyema dying in fourteen days and less; average of eleven days; both pneumonia and empyema are probably equally responsible for the fatal issue. Death occurring past the twentieth day was due in most cases to sepsis.

Sudden Death. Three of the 122 cases died suddenly. Case 357 was found dead in his barracks by the captain while making his night rounds. The second case (386) died suddenly in a neighboring city and was sick but a few hours with severe abdominal pain and vomiting. Both cases at autopsy showed marked tracheitis, enlarged pulmonary bronchial lymph nodes, pulmonary edema and acute nephritis, and on microscopic examinations, extensive exudation of coagulable material and many areas with alveolar infiltration with round cells, red blood cells and fibrin. Death in these cases was undoubtedly due to an overwhelming toxemia. The third case, one-half hour before death, complained of pericardial pain and vomited. Autopsy showed 2700 c.c. of pus and fibrin in the left pleural cavity; consolidation of the lobular type resolving in the left lower lobe and extensive lung necrosis.

Miscellaneous Bacteriology. The hemolytic streptococcus was isolated from the blood 15 times in 12 cases. Of these 12 cases 6 returned to duty; 3 cases developed empyema and 3 died.

Pneumococcus Type IV was found 14 times in 9 cases and all died.

Staphylococcus aureus was cultured 7 times from the blood stream; 3 developed empyema and 4 died. The staphylococcus was not found in the 2 cases coming to autopsy.

Non-hemolytic short-chain streptococcus was found in the blood cultures three times. Two returned to duty and 1 died.

Pneumococcus Type III occurred in three cultures and all returned to duty.

Two cases with pneumococcus Type I in the blood stream died and 1 with pneumococcus Type II also succumbed.

In all, 63 positive cultures were obtained from 310 specimens.

PLEURAL FLUIDS.

Table "I" of 158 pleural fluids from 75 cases.

	Number of times isolated.	Per cent.
Hemolytic streptococcus	74	46.8
Bacillus influenzae	14	8.9
Hemolytic staphylococcus	22	13.9
Non-hemolytic streptococcus	12	7.6
Pneumococcus Type I	12	7.6
Pneumococcus Type III	8	5.1
Pneumococcus Type IV	5	3.2

SPUTA.

In most of the cases during the pneumonic stage the sputum was composed mostly of mucus, at times blood-tinged and exceedingly unsatisfactory to work with.

Four hundred and fifty-eight sputa were typed during the epidemic. Of these 31.8 per cent. gave the hemolytic streptococcus; 41 per cent. non-hemolytic streptococcus; 23.4 per cent. *Bacillus influenzae*. The pneumococcus type follows, showing the method used in typing:

	Type I.	II.	IIa	III.	IV.
Mouse method . . .	11	3	1	5	13
Avery method . . .	7	8	9	11	100
	<hr/> 18	<hr/> 11	<hr/> 10	<hr/> 16	<hr/> 113

NASOPHARYNGEAL CULTURES.

Experience points to the tonsillar region and the postpharyngeal space as the areas yielding early and fairly reliable evidence as to the character of infection.

The following table shows the prevalence of hemolytic streptococcus and *Bacillus influenzae* by months:

	Cases.	Per cent. of hemolytic streptococcus.	Cases.	Per cent. of <i>influenzae</i> .
September	312	34.25	152	66.00
October	147	25.33	82	27.00
November	640	34.51	464	51.41

November 29, 1918, 57 cases in the tuberculosis ward showed 30 per cent. hemolytic streptococcus and 59 per cent. *Bacillus influenzae*.

December 12, 1918, 55 overseas men arrived at the Base Hospital. Cultures showed 7 per cent. hemolytic streptococcus and 45 per cent. *Bacillus influenzae*.

SUMMARY.

Three phases or stages of the epidemic were observed:

1. Influenza uncomplicated; average duration four days.
2. Influenzal pneumonia; duration twenty-four hours to six days.
3. Septic stage; duration a few days to two months or more.

Stages were not, as a rule, sharply defined, but always occurred in the order set down.

Infection is from above downward through the bronchial tree. The Gram-negative bacillus described may be the causal factor in producing the influenza and influenzal pneumonia, but sufficient evidence is not at hand to establish this, and cause undetermined will therefore be written in. The septic stage is caused by one of the secondary invaders, *Streptococcus hemolyticus*, non-hemolytic streptococcus, staphylococcus or pneumonia group.

No marked leukopenia was observed. Moderate leukopenia in the extremely sick pneumonias almost invariably changed to a considerable leukocytosis before death in those cases where pus was

found at autopsy.- A moderate to a high leukocytosis indicated a secondary sepsis; 93 of 108 charted pneumonia cases without empyema showed evidence of sepsis.

The reason for the marked cyanosis, observed clinically, was found to be extensive lung consolidation, which with the large amount of coagulable material found in the alveoli surrounding scattered areas of consolidation must have made proper aëration of the blood extremely difficult. The three cases of sudden death reported not only point out the extremes of the pathological process but are also of medicolegal importance.

CLINICAL ASPECTS OF PNEUMONIA FOLLOWING INFLUENZA, CAMP DODGE, IOWA, 1918.

BY JAMES G. CARR, CAPTAIN, M.C., U.S.A.,

CHICAGO, ILLINOIS

1. THE statements and conclusions of this report are based on a study of the charts of 274 patients and on personal experience during the epidemic. All the patients included in the formal review of 274 charts were admitted to the hospital in the first five days of the epidemic; we feel that this ensures a study of the typical cases, as the atypical cases are more likely to be seen as an epidemic subsides.

Of the 274 patients whose histories were studied 212 were white, 61 negro and 1 Indian; all were admitted to the hospital with influenza, except 4; in these 4 the history pointed to a prior influenza, but pneumonia was present on admission.

The symptoms and course of the influenza were first studied. The onset is almost always sudden; in 100 charts the definite statement of a sudden onset is made; in 24 the onset is said to have been gradual; but among these 24 many were found in whom it appeared that the patient had not been quite well for a while, had suffered with a "cold," for instance, yet the definite symptoms of influenza had appeared quite suddenly: moreover, even the charts that contained no statement as to the abruptness of onset usually stated the history in a way to warrant the inference of suddenness in onset. Finally, of the 274 patients only 30 stated that they had been sick more than four days; 35 were admitted to the hospital within twenty-four hours of the first symptoms, 111 on the second day, 45 on the third and 17 on the fourth day.

Headache was the most common complaint; it was mentioned 206 times, often being spoken of as severe and the most distressing symptom. Cough was complained of in 194 cases; 3 times it was described as dry, 3 times as associated with a mucous or mucopurulent sputum; in 61 cases the cough was characterized as slight;

chills or chilly sensations were recorded 149 times; history of a definite chill was only found in 12 cases; conjunctivitis, described as smarting or burning of the eyes, was present in 110 cases; coryza, or "cold in the head," in 65; sore-throat in 92. General malaise, muscular pains and aches and aching in the extremities were frequently present; general muscular soreness in 74 cases, backache 92, prostration in 32 and pain in the chest, usually substernal and ascribed to the coughing in 31. Nausea was present 44 times, vomiting 14. Photophobia was noted three times; pain in the left ear and impaired hearing were the only symptoms on admission in one case; the drum membrane was red but not bulging; this patient, on admission, had a normal temperature, two days after admission the temperature was 104.6, four days later a consolidation of the right upper lobe was noted; death ensued on the following day. Epistaxis was present in 22 cases; personal observation leads us to the opinion that minor cases were ignored by the patient; a percentage of 8 is probably too low for the true incidence of nose-bleed. In 4 cases, without history of epistaxis or demonstrable pneumonia, bloody sputum was present. Three of these patients were classed as "very toxic" on admission; in 2 of these recovery by lysis occurred in one week; the third died eight days after admission. Anorexia is mentioned 8 times, but its occurrence was so universal that the only explanation to be offered for the infrequent mention of its occurrence must be that it was taken for granted; it was so nearly universal that the return of the appetite was generally regarded as one of the surest signs of convalescence. Constipation was mentioned 3 times; one patient complained of pain in the right shoulder, abdominal pain and increased frequency of the bowel movements; there was evidence, at entrance, of diffuse lobular pneumonia, but at no time was consolidation noted; death occurred eleven days after admission. No other cases of diarrhea were found. One patient, admitted on the first day of illness, was jaundiced on admission; this patient died fifteen days after admission. One case was kept for four days under observation for smallpox. Four patients, on admission, complained of abdominal pain; 2 of these suggested appendicitis, 1 being first sent to the surgical service; a third has been discussed; aside from the complaint of pain the fourth presented no abdominal findings of interest. The lungs were noted as negative in 125 cases; in 37 there were "diffuse" rales; in 6 of these the rales were described as "moist," rales over both bases were noted twice, over the right base 10 times, over the right side twice, over the left base 6 times, over the right side anteriorly once. Thus out of 184 cases in which the lung findings were recorded, 125, or 68 per cent., were negative at the first examination. The first temperature record was over 103° in 144 cases; of these 54 had a temperature between 104° and 105°; 8 had a temperature over 105°; one of these latter had a temperature at entrance, within twenty-

four hours of the onset of the symptoms, of 107° ; three days later, the physical findings of pneumonia were present; fluid was later suspected, but not diagnosed; death occurred on the tenth day. In 95 cases the first temperature record was between 101° and 103° ; it was below 101° 35 times. The pulse was usually slow in proportion to the temperature. Herpes was not seen.

To review the symptoms of influenza: The onset is sudden, with headache, anorexia and fever usually above 101° ; chilly sensations; cough of variable degree; conjunctivitis; pharyngitis; backache; general muscular soreness and coryza. Symptoms of less frequency, but common and important, are nausea, epistaxis and pain in the chest. A marked apathy is common: delirium of a mild type is common, especially at night, when the temperature is high; it is rarely of an active type before the onset of complications. Pulse and respiration are relatively low. The mouth is likely to get into bad condition; the tongue is heavily coated, sometimes fissured and swollen; sordes are common; the breath is often very offensive.

The charts of 300 patients, discharged with the diagnosis of influenza, were studied for the following points:

1. Duration of the temperature.
2. Frequency of epistaxis.
3. Abdominal tenderness or pain.
4. Records regarding the physical findings of the lungs.
5. Bradycardia during convalescence.

Of the 300 charts studied, 24 warranted the diagnosis of pneumonia; these will be discussed later.

1. (a) Of the remaining 276 charts studied the temperature, at some time, was over 101° in 242, always below 101° in 19; the remainder comprised cases with a history of influenza but no temperature on admission, cases obviously not influenza, or cases discharged from the hospital before the temperature was normal.

(b) In the group of cases with temperature above 101° , 67 touched 101° for seven days or more, 40 for six days, 46 for five, 33 for four, 29 for three, 23 for two and 4 were permanently below 101° after the first day.

(c) Of the total number of cases with temperature, 31 were normal on the fifth day, 46 on the sixth, 45 on the seventh, 43 on the eighth, 30 on the ninth and 54 not until the tenth day or later.

2. Epistaxis was noted in 20 cases; bloody sputum without epistaxis in 1 case.

3. Abdominal tenderness or pain was present 18 times.

4. "Bronchitis" was recorded 5 times; diffuse rales 57 times; rales localized in the right lower lobe 3 times, in left lower 6, in right upper 3, left upper 3, "posteriorly" 3; the lungs were described as negative 196 times. The percentage of cases in which negative findings were noted is 72.3 per cent. as against 68 per cent. in the cases followed by pneumonia; the difference is not significant.

5. Bradycardia was noted in convalescence 76 times; this includes cases in which the pulse record at one or more readings was below 60; many readings under 50 were found.

It is in regard to the cases with prolonged febrile periods that argument is bound to come; essential influenza has not been regarded as associated with a febrile period lasting more than five days at the most; here we have 153 cases out of 276 showing temperatures of 101° or more for five days or longer, yet the clinicians in charge did not find evidence of pneumonia in these cases.

Of the 24 cases whose charts presented a reasonable basis for the diagnosis of pneumonia, but which were regarded throughout as influenza, 17 had temperatures of 101° or over for five days or more; of these, 10 at one time or another touched 104° and 5 others 105° ; 6 of these cases had a record of bloody sputum, 2 showing rales over both lungs, posteriorly, 1 crepitant rales and questionable lung involvement, 4 moist rales over both bases, with "questionable pneumonia," 2 crepitant rales at the bases and 3 dulness over both bases. It seems reasonable to conclude that the cases which run a temperature of 101° or over for six days are pneumonic; the likelihood of pneumonia is greater when the temperature reaches 104° for a day or two, especially if this elevation of temperature occurs after the third day; and the diagnosis becomes more certain when bloody sputum is noted or fine moist or crepitant rales, localized, are discovered.

Further consideration of the temperature is interesting. Of the pneumonia cases studied, 274 in number, the temperature on admission to the hospital was 103° or over in 144 cases; in 54 of these between 104° and 105° , in 8 over 105° . A group of 127 cases of influenza showed a temperature below 101° in 20 cases, between 101° and 103° in 60 cases, between 103° and 104° in 41 cases, between 104° and 105° in 6 cases, none over 105° . Thus of 274 cases, later developing pneumonia, 62, or 22.7 per cent., had initial temperatures above 104° ; of 127 cases not developing pneumonia, 6, or 4.17 per cent., had initial temperatures over 104° ; evidently the initial high temperature of influenza should serve as a warning signal.

As to the relationship of the temperature curve to the onset of pneumonia, four types of unequal importance have been observed, the first two being the important ones:

1. Continued high temperature, usually with gradual development of pneumonic signs and symptoms; increasing prostration, cyanosis, rapidity of the pulse and respiration; definite findings of consolidation are likely to occur late, if at all, in these cases; the physical findings may be nothing more than dulness over both bases, with progressive involvement of the lung shown by many fine or coarse rales.

2. Secondary rise of temperature, often associated with bloody

sputum, aggravation of the prostration, increase of the cough, which becomes less after a day or two; a chill may precede this secondary rise or thoracic or abdominal pain may be associated.

3. A less frequent type, in which there is a steady decline of the temperature; this usually means a moderately extensive pneumonia, with early termination by lysis; but this same type has been observed in fatal cases.

4. An infrequent type in which the temperature curve is irregular throughout.

Differentiation between groups 1 and 2 was arbitrarily made; if the temperature did not fall below 102° the case was included in the group of continued temperatures; when the temperature fell below 102° the case was classed as one of secondary rise; with the onset of pneumonia the temperature usually rose to 103° or more; of the 274 cases, 93 showed a definite secondary rise, 117 were of the continued type; the others belonged in groups 3 and 4; even in the cases classed as continued there was likely to be a distinct rise of temperature with the onset of pneumonia, though it had continued above 102° . Other symptoms noted as associated with the onset of pneumonia were: pain in the chest in 33 cases, bloody sputum in 39, chill in 5, "more toxic" in 3, hemoptysis once, increasing cyanosis twice; in 48 instances the secondary rise of temperature evidently stimulated the search for definite evidence of pneumonia.

The physical findings, as first discovered, were variable; consolidation in the right lower lobe was noted 73 times, in the left lower 57 times, in the right middle 5, right upper 7, left upper 2, both lobes, left side, 6 times; diffuse rales over both bases were the first findings 40 times; rales about the angle of the right scapula 18 times, about the left 11 (our own experience leads us to believe that many of the cases noted as beginning with consolidation in the right or left lower lobes, probably began with rales about the lower angle of either scapula); scattered rales were noted 22 times.

In other cases, patches of consolidation, fine moist rales or typical crepitant rales were noted in various situations.

The type of pneumonia present in these cases does not usually remain confined to one lobe; the pneumonic process is progressive, ultimately involving a large part of both lungs. Physical findings at the height of the disease showed consolidation in the right lower lobe alone 64 times; right lower and middle 6 times; the entire right side in 4 cases; the left lower lobe was involved alone 45 times; the entire left side twice; in 6 cases the only findings were rales over both bases; 5 of this group of cases terminated fatally, 1 in recovery by lysis; both bases were "dull with rales" 15 times; 6 times the right lower lobe showed consolidation with rales in both bases; the left lower lobe with rales in both bases 13 times; 11 cases showed irregular bilateral involvement; 1 case showed a left upper

involvement terminating by crisis, followed a day later by involvement of the right lower; another chart contains a record that "crepitant rales in the axillary region of the right side" were present three days before death; evidently no more conclusive evidence of pneumonia was found. One record reads: "Not enough lung findings to justify diagnosis of pneumonia;" this record was made on the day before the patient's death. Another records: "Moist crepitant rales over all;" this was the last record made before the patient's death, two days later. Edema of the lungs was noted 13 times; our own experience leads us to believe that a terminal edema such as is common in ordinary lobar pneumonia was not common in this epidemic. Two points need emphasis:

1. At autopsy, though the signs of consolidation might have pointed clinically to the involvement of only certain parts of the lung, the process had actually involved much more than had been suspected.

2. Some cases at the onset were characterized by anomalous physical findings; impaired resonance, with fine moist rales, diminished fremitus and feeble breath sounds.

Epistaxis occurred 8 times in the course of the pneumonia, in cases in which it had not been present in the influenzal stage; 2 patients had hard chills in the course of the disease. These occurred independently of the administration of glucose, peptone or formalin, which was often followed by a severe reaction with a hard chill; in 40 cases delirium was noted; 36 of these patients died; obviously only the severer degrees of delirium were noted; 54 patients, of whom 42 died, were noted as cyanotic.

An irregular pulse was noted 4 times; only 1 cases of auricular fibrillation was seen personally; this was in a patient with complicating pleural effusion and pericarditis, the latter of which at autopsy proved to be frankly purulent. Some of the instances of recorded irregularities of the pulse were probably incorrect; it was easy to fail to perceive beats when the pulse became very weak and rapid. One patient had very marked drenching sweats; another had persistent vomiting. In the 274 cases frontal sinusitis occurred once, otitis media 4 times. Hoarseness was noted three times; edema of both eyelids once; abdominal distention 4 times; icterus 5 times, an incidence of 2 per cent. Involuntaries were noted but once; urinary retention was more common, 3 patients requiring catheterization.

There were records of urinary examination in 42 cases; 13 of these were negative; the others showed, generally, a high specific gravity, with albumin and casts, hyaline and granular; red cells were noted once; of the patients with negative urines, 5 recovered; a single urinary examination evidently has no prognostic value.

The onset of the pneumonia as determined by the secondary rise of temperature, the occurrence of a presenting symptom, as pleuritic

pain or bloody sputum, or the discovery of physical findings, dated from the onset of influenza, as stated by the patient, occurred as follows: in 3 cases within twenty-four hours, 19 times on the second day, 24 times on the third, 44 times on the fourth, 41 times on the fifth, 41 times on the sixth, 32 times on the seventh, 25 times on the eighth, 22 times on the ninth and 13 times later than the ninth day; out of 264 cases in which the onset of the pneumonia could be determined with a fair degree of accuracy, 126, or 47.7 per cent., began on the fourth to sixth days inclusive; including the incidence on the third day, 56.8 per cent. began on the third to sixth inclusive; in 172, or 65.2 per cent., the onset was before the seventh day after the onset of the initial symptoms of influenza.

COMPLICATIONS. Thirty-three cases showed severe pain in the chest, probably due to pleuritis: in 8 cases severe abdominal pain was noted; in one of these there was an associated diarrhea; the others were probably referred from a pleuritis, making together 40 cases of pleuritis; to these must be added 4 cases "of thickened pleura," one with a friction rub but no pain and 3 with fluid without pain, a total of 48 cases of pleuritis, a percentage of 17.5 per cent. Pleural effusion was diagnosed and proved by aspiration 9 times; it was probably overlooked several times; "thickened pleura" was diagnosed 4 times; in only one of these 4 cases was aspiration done; autopsy experience does not warrant the diagnosis "thickened pleura" in a disease of such short duration, occurring in otherwise healthy young men; the pleura was not sufficiently thickened to interfere perceptibly with the transmission of voice and breath sounds or of fremitus in any of the cases which came to autopsy early. In another case the record shows that "fluid" is suspected; four days later "the symptoms of beginning resolution are present;" on the following day this patient died. Again, after several days of sickness, physical findings of pneumonia are "less pronounced" only three days before the patient's death; in another case, four days after admission and four days before the patient's death, we find voice and breath sounds diminished when they had been previously exaggerated; in a further instance, two days after crepitant rales had been heard, the record reads, "Right side flat; distant breath sounds."

These cases are cited to emphasize the danger of overlooking this serious complication. The accepted signs of pleural effusion are modified, not abrogated; flatness, absence or diminution of voice or breath sounds, or of tactile fremitus, egophony, Grocco's sign, displacement of the heart are as important here as elsewhere; but breath and voice sounds increased by consolidation will be heard through fluid. The dulness is likely to be shifting in character, adhesions are not found early, and thus is explained the frequent occurrence of "movable" dulness. Rales were often heard through fluid. The diminution of the tactile fremitus, in our experience,

was the most valuable sign, especially if found over an area of confluent pneumonia which had previously shown increased fremitus; it is of great importance also if diminished fremitus is found in association with increased voice and breath sounds. Distant tubular breathing was frequently heard through fluid, and the diminution of fremitus with the continued presence of increased voice or breath sounds, or without them, over an area in which they had once been distinct, was of the utmost importance. The diagnosis of resolving pneumonia, because of the disappearance of the characteristic pneumonic findings, while the patient is still obviously sick, should be made with the greatest of caution; it is likely that a complicating empyema has caused the change in physical findings. The presence of a definite leukocytosis before the discovery of physical findings is suggestive; after their discovery it is a valuable confirmatory sign, though the presence of leukocytosis does not necessarily mean pleural effusion; it occurs with other complications or without them. In the use of the term "definite leukocytosis" a count of 15,000 or above may be accepted as an arbitrary limit.

Pericarditis sicca and with effusion occurred in several cases: in one case the discovery of the rub was preceded for one day by pain in the left shoulder. Endocarditis was rare.

Symptoms pointing to an abdominal lesion were seen in 8 cases; 4 have been discussed; of the remaining 4, 1 required differentiation from appendicitis, 1 had pain chiefly confined to the pit of the stomach, of which no further mention was made; 1 had no further record than of severe abdominal pain; the fourth died with the symptoms of peritonitis, "abdominal tenderness, distention, rigidity and vomiting, complicating a pneumonia and empyema."

The 274 cases studied did not present all of the complications seen during the epidemic, and the records made in the rush of extraordinary work are not always complete; to give a better picture of the many complications incident to the disease we must make use of our experience, fragmentary and incomplete as that may be.

As to the incidence of complications affecting the ears, eyes, nose and throat we quote the following personal report of Captain Kent E. Williams, of the Head Surgery Department; this report includes all complications of this nature occurring in influenza and pneumonia patients seen by him September 29 to October 20 inclusive:

Otitis media suppurativa chronica	10
Otitis media (simple) non-suppurativa	275
Otitis externa hemorrhagica	120
Laryngitis, acute	76
Sinusitis, acute	36
Tonsillitis and pharyngitis, acute	200
Epistaxis	217
Conjunctivitis, acute	27

Captain F. M. Manson, of the Surgical Service, reports that during the epidemic 105 cases of pleural effusion were seen; 64 of

these patients are still in the hospital; 41 have died, a mortality thus far of 39 per cent. of the cases of pneumonia complicated with empyema. Early the effusion is seropurulent; later it becomes distinctly purulent. Empyemata localized to the region of one or the other upper lobes have been diagnosed and aspirated; in these cases the roentgen rays are of particular value. Abscesses have been found in the mediastinum several times at autopsy; the report from the director of the laboratory describes them.

The relationship of tuberculosis to the prevalent influenza and pneumonia is still uncertain; several cases of simultaneous occurrence of the two diseases have been seen clinically and at autopsy; what influence the present epidemic may have in predisposing to tuberculosis is a problem for future work.

Subcutaneous emphysema, beginning in the tissue of the neck and upper part of the thorax, was seen in several cases; in some instances the process spread over the entire trunk, even involving the arms; in 1 case the scrotum was involved. Only 3 patients are known to have recovered; 3 went to autopsy; the report from the pathological department will discuss the origin and pathogenesis of this complication. In general it was found only in cases of the most severe type.

Meningitis was seen 5 times; 4 of the cases showed pneumococcus in the spinal fluid. None of these recovered. In another case, coming on after the subsidence of the pneumonia, spinal fluid showed a positive Wassermann; recovery followed under appropriate treatment.

Two cases of persistent singultus were found; in both cases this symptom preceded the development of frank pneumonia. Another patient had "coffee-ground" vomitus in the forty-eight hours just preceding death; autopsy revealed a ruptured esophageal ulcer, probably secondary to an extensive suppurative mediastinitis. One other case of ruptured esophageal ulcer was seen at autopsy.

Two cases of multiple arthritis were seen; in 1 of these endocarditis developed: in 2 other instances septic arthritis was found at autopsy. Thrombophlebitis of the femoral veins was seen a number of times; in 1 case it was bilateral.

There were 2 cases of severe pulmonary hemorrhage; 1 patient died in a short time; the other has since presented one of the few cases of empyema located over an upper lobe, which has been drained, and the patient's condition is good.

Lieut. Ramsay, of the contagious wards, reports 14 cases of erysipelas in pneumonia and influenza patients; 12 recovered. One of these patients, thirteen days after admission with a severe pneumonia, when apparently improving, developed a streptococcus sore-throat, with marked edema of the uvula; facial erysipelas appeared the next day; within another twelve hours death ensued as a result of edema of the glottis and larynx.

COURSE. Crisis occurred in 15 of the 274 cases, in all except 1 before the seventh day; the one exception had the crisis on the tenth day; 3 terminated by crisis, extending over thirty-six hours; 98 cases terminated by lysis; thus of 115 cases studied, which terminated in recovery, 14.7 per cent. terminated by crisis. In the cases terminating by lysis, return to normal temperature was most frequent from the third to the sixth day inclusive, but in 13 instances was prolonged beyond the tenth day. In the cases terminating fatally 4 died within twenty-four hours of the discovery of pneumonia, 6 on the second day, 24 on the third, 14 on the fourth, 17 on the fifth, 17 on the sixth, 10 on the seventh, 17 on the eighth, 7 on the ninth, and 2 on the tenth day; thus 121 terminated within ten days after the onset of pneumonia; 35 died after the tenth day; where empyema develops, except in the more virulent cases, the course is prolonged. An interesting feature was the discovery during examinations for discharge to convalescent barracks, after a week or more of normal temperature, that about 20 per cent. of these patients, apparently well, still presented definite physical findings of pneumonia; in a few cases quite extensive.

DIAGNOSIS. The diagnosis of pneumonia rests finally on the discovery of the essential physical findings; bloody sputum, aggravation of the general condition, chill, pain in the side or abdomen, create the suspicion of pneumonia; the temperature curve either of the continued type or showing the characteristic secondary rise is of importance; in the influenzal stage the leukocyte count is usually low; with the onset of pneumonia it is likely to increase, though this is not invariable, and in uncomplicated pneumonia, it is not often above 15,000.

The diagnosis of empyema has already been discussed at length; it may be added that the presence of a definite leukocytosis is a valuable adjunct in diagnosis. The roentgen rays are valuable, especially in localizing the effusion.

PATHOGENESIS OF THE CYANOSIS. 1. This may be due to the virulence of the infection, producing an overwhelming toxemia; this factor alone, by its action on the vasomotor center, may produce the cyanosis.

2. Autopsy showed, in many of the cases, very extensive pulmonary involvement, sufficient in itself to produce death, practically by suffocation.

3. Autopsy revealed, in a large number of cases, macroscopic changes in the adrenals; blood-pressures were not taken, so the possible effect of adrenal change on blood-pressure in these cases can only be discussed theoretically; however, it appears possible that the early collapse in many of these cases was partly the result of adrenal insufficiency.

Prognosis is uncertain; sudden change, inexplicable in the light of our present knowledge, for better or worse, is a common event.

For individuals at the same time of life the mortality is much greater, in general, than is that of the ordinary lobar pneumonia. When the pulse and respiration remain relatively low the outlook is usually good; increasing cyanosis, tendency to hemorrhage, icterus, progressive involvement of the lung, active delirium, increasing rapidity of the pulse and respiration are of bad prognostic import. It is fairly characteristic, in the fatal cases, for pulse and respiration to go up while the temperature goes down. The patient's sense of well-being is often misleading; many times the mind remains clear until near the end and the desperately sick patient will express himself as "better." Empyema is a complication of gravity; abdominal distention and the subcutaneous emphysema mentioned were only found in serious cases.

TREATMENT. The forms of special treatment employed will be discussed in the report of the chief of the medical service. The general treatment consisted of rest in bed (especially to be recommended as a prophylactic measure as the influenza subsides), fresh air (the patients were kept on the porch in favorable weather), administration of fluids and soft diet and attention to the bowels. Digitalis, strychnin and camphorated oil were extensively used; whisky was employed in some cases; none of these agents have commended themselves as of value. Codein or heroin are advised to control excessive cough; morphin to quiet delirium when the patient was obviously exhausting his strength; it is also used to give a night's restful sleep. Horse serum was used subcutaneously for the cases with a notable tendency to hemorrhage. Atropin, pituitrin and enemata, plain or of asafetida, or milk and molasses were used in the cases of abdominal distension. The mouth needs care. The treatment of empyema will be discussed by the chief of the surgical service.

CONCLUSIONS. 1. The prevailing epidemic of so-called influenza is characterized by two stages: the first, in which the symptoms are those of a severe infection of four or five days' duration, involving particularly the upper respiratory tract, and the second, coming on about the fourth to the sixth day after onset, is characterized anatomically by pneumonia of a lobular type, or of the form known as interstitial bronchopneumonia; in either case the process becomes confluent, giving the physical signs of consolidation; in its course the disease differs from lobar pneumonia of the common type in that a chill at the onset is not common and crisis is an unusual termination.

2. The pneumonia is often virulent in type, characterized by cyanosis, extreme prostration, a tendency to hemorrhage and the frequent occurrence of an early empyema.

3. Pneumonia develops usually by the sixth day of the influenza; the course of uncomplicated pneumonia is usually complete in less

than ten days; termination is by crisis in about 15 per cent. of the cases.

4. There is a tendency to complications of a septic nature; purulent accumulations occur in various situations; mediastinal abscesses, empyema, septic arthritis, muscular abscesses, otitis media have been seen; erysipelas may also be a complication.

5. Of uncertain etiology we have no rational method of treatment; the essential feature, the bacteriological causative factor, must be determined before we can look forward to specific therapy. Prophylactic measures are now the most important; these should be carried out, in the light of the established fact that the disease is transmitted by contact infection. Once the pneumonia is established we must rely on general measures of treatment.

6. It is imperative that patients should not be discharged from observation too early. Prophylaxis should include protection of the patient from exposure or undue activity for some time after apparent recovery; in view of the fact that physical findings persist for some time after the general condition is good (definite evidence of considerable fluid was found in one patient, after he had been up and about several days), and in view of the further fact that activity of every sort seems to lessen resistance to the disease, too great care can hardly be used to protect the convalescent patient from recrudescence or complications.

7. The indications for aspiration of pleural effusions are, in our opinion, not clearly defined; at the height of the pneumonia the effusion has a marked tendency to recur, causing a rapid loss of fluid when large amounts of fluid are aspirated often; after the occurrence of the subcutaneous emphysema, already noted, and the failure to discover any cause for it, except bronchial and peribronchial necrosis, we felt that caution must be used to avoid injury to the lung by means of negative pressure employed to withdraw fluid; finally, there still remains the possibility that the pleural effusion is at first a conservative process. The entire subject will be discussed in the report of Captain Manson, but we may state the indications, as they appeared to us; numbers 1 and 2 are definite indications for interference.

(a) The discovery of frank pus, especially after the height of the pneumonic process had passed.

(b) Definite evidence of mechanical embarrassment on the part of the heart.

(c) Small effusions early are better left alone; later if purulent they must be removed.

(d) Larger effusions even when displacing the heart had better be removed by repeated aspirations of 500 c.c. or thereabouts at a time.

REPORT OF THE SURGICAL SERVICE, U. S. ARMY BASE
HOSPITAL, CAMP DODGE, IOWA, ON THE EPIDEMIC
OF INFLUENZA OF 1918.

BY FRANK M. MANSON, M.D., CAPTAIN M. C., U. S. A.,
CHIEF OF SURGICAL SERVICE, WORTHINGTON, MINNESOTA.

THE surgery of the epidemic was preëminently that of empyema, although the following surgical complications arose during the epidemic:

- 14 cases of mastoiditis.
- 105 cases of otitis media.
- 1 case of frontal sinusitis.
- 4 cases of purulent peritonitis.
- 2 cases of appendicitis (ruptured).
- 4 cases of multiple abscess.
- 1 case of phlegmon of the neck.
- 1 case of phlegmon of the chest.
- 1 case of ileus (mechanical).
- 1 case of edema of glottis.

It is considered of sufficient interest to mention that about 30 cases of pneumonia developed symptoms strongly suggestive of surgical lesions of the abdomen, which were seen in consultation with the medical service; so closely did some of these cases with chest pathology simulate appendicitis that three of the cases were transferred to the surgical wards with the diagnosis of appendicitis, but the true condition was discovered in time and none of them were operated. There were two cases of appendicitis which were operated and found to be gangrenous appendicitis, each giving a history of previous attacks of appendicitis. A third case which was diagnosed as appendicitis, and which was unoperated, died with peritonitis, which was shown to be due to a right perinephritic abscess.

The total number of empyemata, recognized by antemortem aspiration and by autopsy from the beginning of the epidemic, September 29, 1918, to December 31, 1918, was 150, an incidence of empyema to pneumonia of 1 to 13; inasmuch, however, as all autopsies were discontinued for eleven days during the height of the epidemic, it must be assumed that these figures representing the incidence of empyema to pneumonia are not sufficiently high.

The average time which intervened between the diagnosis of pneumonia and the diagnosis of empyema in the 64 treated cases in the first month of the epidemic was six days; the average time for the 41 treated cases occurring after the first month was twenty-one days and the average time for the entire series of 105 treated cases was eleven days. Many of the cases admitted into the hospital with pneumonia showed pleural effusion present at the time of

admission, and the shortest interval after admittance before the recognition of pleural effusion was one day.

The bacterial flora of the pleural fluids from the treated cases was found to be—

No. of cases showing	hemolytic streptococci	29
" " "	hemolytic streptococci with other organisms	19
" " "	non-hemolytic streptococci	4
" " "	non-hemolytic streptococci with other organisms	3
" " "	staphylococci	4
" " "	staphylococci with other organisms	6
" " "	pneumococci	11
" " "	pneumococci with other organisms	9
" " "	influenza	1
" " "	no growth	6
" " "	with no report	14

In 23 cases in which the streptococci were found the chains averaged 14 cocci to the chain.

Every empyema in the series was, clinically, secondary to pneumonia, except 3, and these 3 cases, in the rapidity of development of the pleural effusion, may have obscured the early pneumonia symptoms, for every case of empyema that went to autopsy revealed some pneumonic involvement.

In many respects the empyemata of the influenza epidemic resembled clinically and morphologically the empyemata of the pneumonia epidemic, which occurred at this camp during the spring of 1918, and the course in the present as in the former epidemic depended upon the virulence of the infection, the degree of pneumonic involvement and the accessibility of the pus collection for drainage. Among the early cases of the epidemic there were many of the fulminating type in which the victim was so overwhelmed with the septic process that he died in a few days after the initial chill and onset of fever, usually with fluid in one or both cavities.

The rapidity with which the fluid accumulated in some cases was remarkable; it was not uncommon to find at autopsy 1500 to 2000 c.c. of fluid, with no definite signs twenty-four hours before death. At times from 500 to 1200 c.c. would be found at autopsy in one pleural cavity, unrecognized before death, with perhaps a draining empyema on the opposite side. We have seen 1200 c.c. of turbid straw-colored fluid with streptococci in large numbers aspirated in less than twenty hours after recognition of the pleural friction rub. The character of the fluid found in the rapidly fatal cases was usually cloudy, yellowish or serosanguinous, and commonly contained small and large masses of fibrin.

In the early cases (fulminating), which occurred in the first month of the epidemic and which showed an enormous mortality, the clinical picture was usually that of a septicemia in which the empyema was but one of the concomitants of a virulent infection, and had, as commonly associated lesions, septic pneumonia, purulent

pericarditis, endocarditis, adrenalitis and purulent peritonitis. The pneumonic process exceeded by far the empyema as a factor, determining the death-rate in these fulminating cases, for at times the consolidation involved as much as four-fifths of the entire lung area. The mortality of this type, therefore, was essentially that of pneumonia, with septic complications, rather than the mortality of empyema, as we were accustomed, formerly, to regard the mortality of empyema which followed lobar pneumonia.

The mortality of the 94 cases of empyemata which occurred during the first month when the epidemic had its greatest virulency was 70 per cent.; the mortality of the 64 cases treated during this same period was 56 per cent.; the mortality of the 52 cases after October 31, 1918, was 40 per cent.; and of the 41 treated cases after October 31, 1918, was 24 per cent.; the mortality of the entire 150 treated and untreated cases was 60 per cent. The virulence of the epidemic during this period was also evident in the mortality rate for pneumonia without empyema, which was approximately 40 per cent. for October, 1918, and about 36 per cent. for the entire epidemic of pneumonia without empyema. The mortality as influenced by different methods of treatment will be discussed under treatment.

The diagnosis of empyema was often difficult, and it was impossible to lay down definite signs which would establish the presence of pus, since the classical signs of fluid were usually masked by the bizarre complex of physical signs that characterized this type of pneumonia. The signs as found during the disease could be explained at times only by the study of postmortem findings.

Frequent and regularly repeated examinations with descriptive notations were essential in the recognition of advent of the pleural effusion. When the patient was studied, with frequent examinations, the advent of pleural effusion could be recognized by dulness, flat and woody in character, by distant breath sounds, diminished or absent tactile fremitus, especially if these signs were noted first in the diaphragmatic angle and had progressively ascended. The displacement of the heart and liver often indicated effusion. Frequent measurements of the area of cardiac dulness by Cabot's method were extremely useful in the recognition of cardiac displacements and pericarditis and afforded some basis for suspecting mediastinal pus pockets. The association of dulness, absent fremitus and pectoriloquy was found to be very reliable in locating pus collections.

When the opportunity of following the development of physical signs was not afforded the diagnosis of pleural effusion became much more difficult, since the physical signs were varied and atypical: one, for instance, might find a pneumothorax with an effusion, or bronchial breathing or an increase of the whispered or spoken voice sounds over fluids; crackling rales were often heard over effusions,

especially in the cases having thick pus. The temperature and pulse might show little change. In cases occurring later after pneumonia the presence of pus is often indicated by a rise of the leukocyte count, pulse and temperature. After aspiration or drainage the interpretation of the physical signs was usually extremely unsatisfactory. The pleura frequently was covered with a heavy fibrinous exudate, and this condition was difficult to differentiate from pleural effusion, particularly if consolidated lung were back of the pleural deposit. Here the x -rays sometimes helped out, but frequently the only means of deciding was the aspirating needle; if the needle entering the chest continued to meet with resistance a pleural exudate or adhesions were considered present.

The x -rays were found to be valuable, indicating fluid, when the amount was 500 c.c. or more, in which case the rib shadows were obliterated and the costodiaphragmatic angle obscured. Contrary to our previous understanding the shadow which was cast by thick pus was lighter than that cast by serous fluid, and at times it could not be decided from the shadow cast whether or not pus was present. The shadow cast by sanguinous fluid was relatively dense. The roentgen rays were found particularly valuable in outlining pus accumulations with fibrinoplastic exudates, and showing by stereoroentgenograms the location of smaller accumulations after a chest had been aspirated. Roentgen-ray plates were valuable in demonstrating when there was collapse of the lung and also the presence of separate pus pockets. After drainage was established it was valuable in showing the extent of the collapse or expansion of the lung and the reduction in size of the cavity and the position of the drainage tube. It was of little value in diagnosing mediastinitis, as were all other diagnostic methods. Subcostosternal pus pockets and purulent mediastinitis were found in 17 per cent. of the cases at autopsy, but were seldom diagnosed before death, although their presence was at times suspected from the combination of clinical and roentgen-ray findings. Interlobar empyema occurred in about 8 per cent. of the cases and were diagnosed with no little difficulty. They were usually suspected in a patient who ran a prolonged illness with increasing temperature and high leukocyte count and in whom repeated aspirations had been negative. Here the x -rays were valuable in locating by stereoscopic plates the location of the empyemic cavity, which could then be more readily confirmed by the aspirating needle over areas which showed dulness with absent fremitus and pectoriloquy.

The pathology of empyema was found at autopsy to be that of bronchointerstitial or lobular or mixed lobar pneumonia, with purulent pleuritis with adhesions, unilateral in 36 cases and bilateral in 11 cases. There were 28 cases found on the right side and 19 cases on the left side; 24 cases were bilateral. Of the 105 treated cases 60 were on the right side and 45 cases were on the left side;

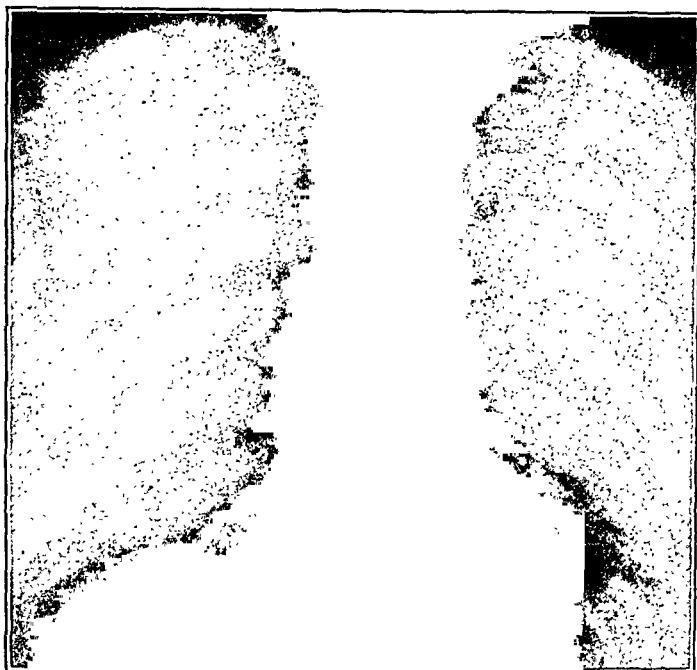


FIG. 1.—Reproduction of roentgen-ray plate fourteen days after thoracotomy, with large tube and tight closure of wound about the tube; 250 c.c. pus withdrawn at time of operation, tube connected with siphon bottles for constant negative pressure, yet large pneumothorax visible, showing that this type of drainage does not maintain constant negative pressure.



FIG. 2.—Reproduction of roentgen-ray plate, showing appearance of chest seven days after operation with trocar and cannula; 2250 c.c. pus were removed at the time of operation, yet the lung is expanded and there is no pneumothorax.

only 1 case was diagnosed as bilateral before death; 17 cases showed pleural pus pockets. Encapsulated pus was found in various locations in 28 cases. Pulmonary abscesses were found in 11 cases. The subcostosternal pus pockets were situated between the edge of the affected lung and the pericardium directly under the sternum extending to one or both sides and at times communicating with an empyema cavity. They might extend to the hilus of the lung or communicate with a septic cavity back of the lung. The lymph nodes at the hilus of the lungs were swollen and soft. Purulent or serous pericarditis was found in 10 cases antemortem and 25 cases post-mortem, and apparently in a few cases was secondary to mediastinitis or substernal pus pockets, and in one case (Private H.) there was a gangrenous area on the pericardium, contiguous to a gangrenous area of the lung. The striking feature of the pericarditis was the frequent massive vegetations on the heart, sometimes so abundant as to change the entire appearance of the heart; also the enormous amount of fluid in the pericardial sac (one case having 750 c.c.). Infection of the pleural cavities was thought to be by direct extension through the visceral pleura; every empyema had been shown at autopsy to be associated with a pneumonic process, and definite septic infarcts, varying in size and number, were found in a few cases in the periphery of the lung; in one case both lungs appeared studded with pea-sized septic areas. While the infection seemed to spread in the chest by contiguity many cases were clinically septicemias, since they showed the association of endocarditis, phlebitis, arthritis, pericarditis, subcutaneous abscesses and other septic complications. Arthritis was seen in 3 cases antemortem, and purulent arthritis was found in 1 case; peritonitis with empyema was diagnosed in 4 cases and found in 9 cases at autopsy.

The treatment of empyema, as a result of our experiences at this base hospital in the spring epidemic, was based upon two conclusions: (1) to tide the patient, seriously ill with pneumonia and empyema, over his critical period, by one or more aspirations, thereby preserving for him all his remaining respiratory function, by avoiding a pneumothorax and collapse of the lung, also avoiding any shock from the trauma and excitement of an operation for drainage, when he was least able to stand it; (2) to maintain a continuous negative pressure in the pleural cavity while being drained, thus shortening the convalescing period by securing expansion of the lung with a constant, rapid lessening of the empyema cavity.

Approximately the first 43 cases of empyema were treated with repeated aspirations and the injection of 2 per cent. formalin glycerin, subsequent aspirations were done when the fluid reaccumulated or when there was evidence of absorption of toxins. The aspiration was done slowly with a Potain apparatus, and unless the patient showed signs of cardiac embarrassment or pains in the chest, with severe cough, indicating a possible edema of the lung, the

quantity withdrawn was not arbitrarily limited. We have seen striking benefits from the withdrawal of large amounts of fluid in patients considered *in extremis*: Private G., for example, had bilateral pneumonia, cyanosis, imperceptible pulse, cold, sweaty skin, and was so desperately ill that we hesitated to subject him to the supposed additional hazard of aspiration; but he improved immediately upon the withdrawal of 1800 c.c. of purulent fluid and is now convalescing from his empyema. Only 2 per cent. of our cases exhibited circulatory or cardiac embarrassment when aspirated. The largest amount of fluid withdrawn at one aspiration was 3200 c.c., which was done without any cardiac embarrassment. Private J., cyanotic, with marked dyspnea and very rapid pulse, was relieved immediately by withdrawing over 2000 c.c. of fluid at the first aspiration; and approximately the same amount was withdrawn on two subsequent occasions. The average amount of fluid withdrawn at the first aspiration in the entire series was 726 c.c.; the average time between aspirations was four days. In this group, which was aspirated and injected with formalin-glycerin, 13 had one aspiration, 13 had two aspirations, 12 had three aspirations, and 5 had four aspirations.

At each aspiration a specimen of the pus was sent to the laboratory for bacterial count, in order to determine the effect of the formalin-glycerin; the results, however, did not justify the conclusion that 2 per cent. formalin-glycerin in these cases showing excessive amounts of pus, was of any considerable value, and, on the other hand, it was found that its use in the pleural cavity caused any harm.

In the group of severe and rapidly fatal cases of treated empyema (64) seen in the first month of the epidemic, 36 died, 24 had operations for drainage and 4 drained through the mouth by way of a bronchial fistula without aspiration; 11 of the empyemata that died had an average duration of five and a half days following the diagnosis of pneumonia, one died two days after diagnosis of pneumonia, confirming the opinion that the mortality of the early empyema was that of pneumonia. Many cases of the epidemic were so rapidly fatal that death occurred before aspiration could be done. One of the cases that drained through the mouth by means of a bronchial fistula suggests the danger of delaying thoracotomy on the supposition that if the patient is expectorating pus he can safely drain his empyema that way without operation, as apparently did a few others; this one patient who was expectorating considerable pus was the victim of a sudden bursting through of an accumulation of pus at night, drowning in his own pus.

Aspiration has proved of distinct value, although at the best a temporary expedient; it is indicated when the patient is in the critical stage of his pneumonia and has the additional handicap of a large pleural effusion that mechanically and through the absorption

of toxins tends to turn the balance against him. The experience of this hospital has been that rib resection or even thoracotomy at this time might be attended by a serious outcome by producing a pneumothorax and its attendant danger, collapse of the lung, with still further limitation of the already limited respiratory capacity. Repeated aspirations done early and without pain under novocain will tide the patient over to a time of increased resistance.

When the cases came to the stage of required drainage, simple thoracotomy under local anesthesia and continued negative pressure were tried in a number of cases; our method was to introduce the aspirating needle at the site selected for operation, which was usually the eighth or ninth interspace in the postaxillary line. If pus was found the aspirator was disconnected from the needle and it was left in the pus cavity as a guide for the knife. A 1 inch to $1\frac{1}{4}$ inch incision was then made along the side of the needle into the cavity and a special drainage tube inserted, the incision being sutured or packed around the tube, care being exercised at all times to prevent the entrance of air into the chest.

The special tube consisted of a heavy walled rubber tube, $\frac{5}{8}$ inch in diameter, through which ran a Carrel tube, which entered the large tube just outside the skin level, traversed the length of the tube and again emerged through an oblique opening in the wall of the tube inside the chest. This small tube was connected with a Carrel flask for treatment with Dakin's solution, and the large tube connected with a bottle hung on the bed to receive the drainage. Negative pressure was maintained in the bottle by means of a hand pump or by connecting it with two other larger bottles, which would act as a siphon, water being siphoned from the second into the third bottle. This method seemed at first to fulfil the requirements of an ideal treatment, since the operation could be done without pain and shock; since negative pressure seemed possible and since the Carrel-Dakin treatment could be employed. Moreover, by this technic of closing the chest wall against the tube, cross-infection appeared to be eliminated and the frequent changing of dressings avoided.

The practical application of the method, however, established its defects; it was found, for example, that the large tube soon became loose in the wound and admitted air into the pleural cavity with a consequent collapse of the lung, and also drainage occurred along the side of the tube and cross-infection was possible; the tube would occasionally slip out and the method required considerable watchfulness to maintain the siphon apparatus in working order.

Twenty-nine cases were treated thus by thoracotomy with a drainage tube connected with the negative pressure apparatus. Four of these so treated recovered; 19 later had the large tube removed and were treated by the closed method to be described later. About November 8, 1918, through the courtesy of Lieut.-

Col. Joseph Miller, formerly commanding officer of this base hospital, later of the Surgeon-General's office, we learned of the method for treating empyema which was developed by Captain Mozingo, M. C., U. S. Army, at the Walter Reed Hospital, and this method was used on 23 cases.

The essential points in this treatment are:

(a) A single operation under local anesthesia, without danger of shock or collapse of the lung.

(b) The intermittent removal of pus and antiseptic treatment given through a small tube with a hand syringe.

(c) Rapid partial sterilization with Dakin's solution followed later by complete sterilization with 2 per cent. formalin-glycerin solution.

(d) Maintenance of negative pressure in the empyema cavity tending to early obliteration of the cavity.

(e) One dressing which will last several days, with no skin irritation.

Our technic, carrying out the above essential points and differing in a few details from the original method, was as follows: Under novocain or nitrous oxide a 7 mm. trocar with cannula was introduced into the pleural cavity, a small incision in the skin having been previously made over the cavity, which had been determined by the preliminary aspiration. The trocar was withdrawn, leaving the cannula in place, and a 24 F. catheter, with two lateral and one terminal opening, was introduced quickly into the cavity, care being exercised to prevent the entrance of air. The cannula was then withdrawn, leaving the tube fitting snugly in the opening through the chest wall and a hemostat clamped on the tube. Dressings were applied around the tube and these usually did not need to be changed for a week at least, since there was no soiling about the wound. With a 30 c.c. Luer type syringe pus was withdrawn, the tube remaining clamped when the syringe was disconnected, so that no air might enter the chest. The pus was withdrawn in this manner, then 20 c.c. to 50 c.c. of Dakin's solution were injected and sucked out and in several times, in order to churn up and dissolve the pus and fibrinous masses, this process being repeated until the Dakin solution remained practically clear. That Dakin solution does dissolve the fibrinous masses had been experimentally proved.

The cavity was then nearly filled with Dakin's solution and allowed to remain thirty minutes, when it was withdrawn. The treatment was repeated from four to six times in twenty-four hours, the tube being clamped except when aspirating or injecting. When the pus on smear was free from microorganisms the treatment period was extended to twelve hours, and then after each irrigation 30 c.c. to 50 c.c. of 2 per cent. formalin-glycerin were introduced and

remained until the next treatment. When the discharge became sterile to culture and the cavity had diminished to a capacity of 15 c.c. to 30 c.c., the tube was withdrawn and the opening was allowed to heal. An individual syringe and dressing outfit should be used for each patient. If a patient is expectorating pus, caution should be employed in the first irrigation with Dakin's solution, since there may be a bronchial fistula, as has happened in several of our cases that had been operated late after repeated aspirations, in whom an extremely violent paroxysm of coughing evidently was produced by Dakin's solution entering the lung. Subsequent irrigations should be done with normal salt solution or weak Dakin's solution for several days, when the fistulæ usually close, then full strength Dakin's solution can again be used.

Bedside roentgen-ray pictures were repeatedly and systematically taken of all cases, and they proved that negative pressure was maintained and that lung expansion did persist in the cases treated by the closed method; a rapid diminution in the size of the cavity in the cases which had a pneumothorax at the beginning of this treatment was also demonstrated.

Of the 43 cases treated 11 are shown by roentgen-ray plates to be apparently cured of the empyema and have left the empyema ward; 26 are still being treated and at the present time have very low bacterial counts, two to five to the field, with small cavities. The average time between the operation and the closing of the wound was thirty-one days, the shortest time was sixteen days. In discussing the results of treatment it should be mentioned that 37 of these cases had previously repeated aspirations or thoracotomies, and it is not to be expected that the results with this series would be as good as in a series in which the closed method had been used exclusively and instituted early, even before the stage of thickened pus. With the trocar and catheter method the absence of pain so frequently complained of when rib resection was done; the comfort of the patient by reason of clean dressings and ability to move about unhampered by drainage apparatus were apparent. None of the cases treated by this method exclusively developed a pneumothorax, which suggests it as the only method by which a bilateral empyema can be treated. Our experience, we believe, justifies the opinion that the closed method thus described distinctly shortens the course of empyema, since it maintains constant negative pressure in the pleural cavity, prevents the collapse of the lung, promotes early adhesions between the lung and pleural cavity and prevents the secondary infections which are so common after thoracotomies. The simplicity of the technic, the minor character of the operation, the cleanliness and comfort of the patient and the economy of time and of dressings further recommend it as the ideal treatment of empyema so far devised.

The appended table represents the results of our treatment:

	Number of cases.	Drained through bronchus.	Subsequent thor- acotomy.	Subsequent closed method.	Convalescent.	Still under treat- ment.	Deaths.	Mortality, per cent.
(a) Aspirations only	35	8	0	0	11	3	21	60
(b) Aspiration and 2 per ct. formalin-glycerin	43	4	27	21	8	18	17	42
(c) Aspiration with later Brewer tube	25	3	0	17	7	12	6	24
(d) Aspiration with Wilson tube	4	0	0	3	1	3	0	0
(e) Aspiration with later closed method (Mozingo)	19	2	0	19	6	11	2	10
(f) Closed method exclusively (Mozingo)	4	1	0	4	1	4	0	0
(g) Total of (e) and (f)	23	3	0	23	7	15	2	8
(h) Total treated by closed (Mozingo) method after aspiration or aspiration and one of the other methods of thoracotomy	43	0	0	0	11	30	2	4.6

By way of explanation it should be noted that most all of the entire series of 105 treated cases had a combination of treatments, and the above table should be interpreted with this in mind.

REVIEWS

A TEXT-BOOK OF PRACTICAL THERAPEUTICS. By HOBART AMORY HARE, M.D., Professor of Therapeutics, Materia Medica and Physical Diagnosis in the Jefferson Medical College, Philadelphia. Seventeenth edition. Pp. 1023; 145 engravings and 6 plates. Philadelphia and New York: Lea & Febiger.

A WORK of this character, and one which has undergone seventeen editions, with a thorough revision upon each occasion, hardly needs any words of introduction to the medical profession. The book has been prepared with the utmost care and the greater portion entirely rewritten. Throughout the author has cited many of the most recent investigations, and in all instances he gives the reader the benefit of his good judgment, founded upon many years of keen observation and actual bedside results. He has endeavored to sift out the practical facts pertaining to all literature on this subject.

The book is arranged into four parts, each part dealing with a distinct portion of therapeutics. In Part I, Dr. Hare treats of the general therapeutical considerations, in which he points out the urgent need of early diagnosis prior to the resorting to the different remedies. Definitions, modes of action, absorption, ways of administration and general considerations about the patient are given. Part II is entirely given over to drugs, giving their source, physiological action, toxic effects, official preparations and conditions in which they are best used. To this chapter many new drugs, as well as new official names of old drugs, such as arsphenamin, barbital, barbital sodium, procain, etc., have been added. The reader is also urged to use these names and products, as they are now produced in this country and not, as formerly, in Germany. In Part III new methods of treatment have been added. These have been brought out since the beginning of the war, and include the use and preparation of Dakin's solution, Dichloramin-T and chloracosane. They are described in sufficient detail to allow a good working basis and reference for the busy practitioner and student. Lee and Furness's paraffin treatment of burns is also described. In the article upon the treatment of cerebrospinal meningitis; the author's ideas do not coincide with the latest researches upon this disease. Most investigators now look upon this infection as primarily a bacteremia and in such conditions urge early intravenous injections of from 50 to 100 c.c. of the antimeningococcic serum, this dose, in turn,

being repeated as often as the infection requires. This, of course, is carried on in addition to the spinal drainage and the intraspinal serum administration.

In Part IV the author sets forth many of the most modern ideas of treatment. The treatment of diabetes is entirely rewritten and all modern conceptions of the disease have been introduced. The management of the case is given in detail, with such criticisms as have been gained by the treatment of many such cases. As a whole, it is the best quick reference-book on the subject of therapeutics that one can secure.

T. K.

ELEMENTARY BACTERIOLOGY AND PROTOZOÖLOGY. FOR THE USE OF NURSES. By HERBERT FOX, M.D., Director of the William Pepper Laboratory of Clinical Medicine in the University of Pennsylvania. Third edition. Pp. 222; 68 engravings and 6 colored plates. Philadelphia and New York: Lea & Febiger, 1919.

THE reviewer regards this book the best of its kind for the instruction of nurses; the author has chosen the subject-matter with much care and presents it in a clear, forcible and logical manner, with just enough detail to enable nurses and laymen to obtain a good, general grasp of the elements of bacteriology, particularly from the standpoints of etiology and prevention of disease. The illustrations, and especially the colored work, are good and aid the student nurse to grasp and understand her laboratory work, which should always be given in addition to a lecture course.

J. A. K.

HUMAN INFECTION CARRIERS. By CHARLES E. SIMON, Professor of Clinical Pathology in the Maryland School of Medicine and the College of Physicians and Surgeons, Baltimore, Maryland. Pp. 250. Philadelphia and New York: Lea & Febiger, 1919.

THIS rather unique volume is presented to the medical public, to use the words of the author, "As the outcome of the renewed interest which the subject of infection carriers has acquired since the outbreak of the Great War and the resulting necessity of guarding the health of our troops against epidemics." Now that the soldier is returning to civil life it behooves all of us to be on the alert for the carrier, and in this book of Dr. Simon's we have the latest presentation of the subject.

Asiatic cholera, diphtheria, plague, typhoid fever, paratyphoid fever, epidemic cerebrospinal meningitis, bacillary dysentery, acute

poliomyelitis, pneumococcus pneumonia, streptococcus infections and influenza are the diseases considered from the standpoint of their spread by carriers. Each disease is thoroughly covered. Active and passive carriers are discussed; the modes of infection pointed out; the method of recognition of carriers clearly shown; the treatment and management of carriers outlined. An excellent bibliography accompanies each chapter. Altogether, the work is complete and satisfactory, and well worth careful reading.

A. G. M.

A TREATISE ON ORTHOPEDIC SURGERY. By ROYAL WHITMAN, M.D., M.R.C.S., ENG., F.A.C.S., Associate Surgeon to the Hospital for Ruptured and Crippled. Sixth edition. Pp. 914; 767 illustrations. Philadelphia and New York: Lea & Febiger, 1919.

THE present edition of this book shows a few changes of minor importance in the larger part of the volume, but the chapter on military orthopedics has been extensively revised and contains almost fifty more pages and many more illustrations than it did in the previous edition. On account of the war, orthopedic surgery has assumed more importance than ever before, and it is but natural that there should be a great demand for good text-books on this subject. The volume under consideration seems to fill such a need, as it is complete without being bulky, and the fact that it is now in its sixth edition is evidence of its acceptance by the profession.

The section on military orthopedics contains the rules of the selective service governing orthopedic disabilities, showing conditions which may be unconditionally accepted for service and those which must be rejected, and it is interesting to note how this branch of surgery has been able to classify these conditions with accuracy from the functional standpoint. The treatment of fractures in military service is outlined and a lengthy description is given of the Thomas splint, which was of such great value to the allied armies. Bone-grafts, artificial limbs and kineoplastic amputations are all considered, though not extensively described, while nerve injuries and reparative surgery of the nerves are briefly included.

The war being over, the question might be asked relative to the value of all this knowledge in the pursuit of civil surgery, but a moment's consideration will reveal the enormous advantage that will accrue to industrial surgery in peace times as a result of these advances that have primarily been due to the necessities of war. To the orthopedic surgeon this book will need no introduction, while the general practitioner or student will find in this volume all that could be expected of a standard text-book on orthopedics.

F. B. B.

THE OPERATIONS OF OBSTETRICS, EMBRACING THE SURGICAL PROCEDURES AND MANAGEMENT OF THE MORE SERIOUS COMPLICATIONS. By FREDERICK ELMER LEAVITT, M.D., Formerly Assistant Professor of Obstetrics and Gynecology, University of Minnesota. Pp. 466; 248 illustrations. St. Louis: C. V. Mosby Company, 1919.

THIS book deals with obstetrics from the operator's viewpoint and embraces all the obstetric complications that will be encountered and considers the operative procedures at our disposal in the treatment of such accidents. There is no consideration given to normal obstetrical phenomena, such as the physiology and mechanism of labor, which naturally do not fall within the scope of this work. In addition to outlining the technic of the various operative procedures, the dangers incident to the performance of each particular operation are mentioned and the best means to avoid these dangers is described. This is a particularly useful and usually neglected feature in text-books, inasmuch as the average book tends to make the inexperienced reader believe that the operative procedures are as easy to perform as they appear in the illustrations.

There is little in the way of critical comment that a reviewer can offer, inasmuch as the book follows the usual lines of text-book construction. It is well printed and amply illustrated, and with one or two exceptions the statements made by the author are accepted by the profession. The question arises, however, as to whether there is a need for a book of this kind, as all the material contained therein may be found in the more recent standard text-books of obstetrics and, on the other hand, this book is too large to be looked upon as a convenient and compact volume to be carried about by the practitioner in the performance of his obstetric practice to be used as a quick reference.

F. B. B.

UNITED STATES ARMY X-RAY MANUAL. AUTHORIZED BY THE SURGEON-GENERAL OF THE ARMY. Prepared under the Direction of the Division of Roentgenology. Pp. 506; 219 illustrations. New York: Paul B. Hoeber.

THIS book was prepared to serve as a guide to roentgenologists doing work in the military hospitals during the war and as a text-book for instruction in the schools of military roentgenology. It was written by a number of well-known experienced roentgenologists, and is, therefore, authoritative. Experience has proved that it has served its purpose well as a text-book for the beginner and as a means of familiarizing the skilled roentgenologist with physics and apparatus. It is a book which every roentgenologist should possess

and with which he should be familiar, and can be recommended as probably one of the best text-books published so far for use in medical schools. The section on physics was prepared by a well-known physicist who has devoted much time to investigations in connection with the roentgen rays and who has had much to do with developing roentgenology in the army. The section on localization describes in detail the most efficient methods as adopted by the division of roentgenology after a careful study of all methods in use by the allied nations before this country entered the war, with many important improvements added. The section on apparatus describes the appliances devised for military use. Needless to say, these are truly American, and of which we can justly feel proud. The remainder of the book is given up to the essential points of diagnosis, and the subject is presented in a concise and at the same time comprehensive manner.

H. K. P.

ROENTGENOTHERAPY. By ALBERT FRANKLIN TYLER, B.Sc., M.D., Professor of Clinical Roentgenology in John a Creighton Medical College; Roentgenologist to St. Joseph's, Bishop Clarkson Memorial, Ford, Immanuel, Douglas County and Lord Lister Hospitals, Omaha, Neb., etc. Pp. 162; 111 illustrations. St. Louis: C. V. Mosby Co.

THIS little book is intended as a text-book in simple terms for the student in roentgenology to teach him the principles of roentgen treatment. In this way it would seem to serve its purpose in an admirable manner. The only criticism of the book is that the author has not gone more deeply into the subject. The book can be recommended outside the pale of roentgenology as a handy reference for the applications and possibilities of roentgen therapy. The armamentarium necessary for the work is briefly explained, the special applications for roentgen treatment and the technic described and numerous representative cases of various conditions cited.

H. K. P.

THE SCIENCE AND ART OF DEEP BREATHING AS A PROPHYLACTIC AND THE THERAPEUTIC AGENT IN CONSUMPTION. By DR. SHOZABURO OTABE, Assistant Medical Officer, Kensington Infirmary, London. Pp. 113. New York: William Wood & Company, 1919.

IN this little volume the author cites himself as an example of the modern way of living which has long been in vogue in the Western Hemisphere, but not in the Orient. In a terse and concise

manner he describes how he became a strong and healthy man after being affected with osteomyelitis as a child. The entire process he ascribes to his deep-breathing exercises, taken several hours during the day. He prescribes these exercises in moderation in the beginning, with a gradual increase, until the patient continues his deep breathing for a period of four or five hours each day. In this way, he points out, full expansion of the apices of the lungs is obtained, causing a greater blood supply and better drainage. In this way the author feels that he prevents the development of pulmonary tuberculosis. These findings are also based upon limited animal experiments. However, the author leads his readers to believe that a positive blood culture is easily obtained in these cases. This finding is not in accord with other investigators. Cornet's experiments of breathing air containing an attenuated virus of tubercle bacilli without producing primary lung lesions, but a tracheoglandular disease, should not be forgotten in this connection, and the direct benefit derived is by an increased metabolism and resistance of the entire body and not the lungs alone. The book is written in an interesting manner, and will be of benefit to the general public as well as to the physician.

T.K.

RESEARCHES ON THE PATHOLOGY OF MUSTARD-GAS (DICHLOR-ETHYLSULPHIDE) POISONING. UNIVERSITY OF MICHIGAN CONTRIBUTIONS FROM THE PATHOLOGICAL LABORATORY. By ALDRED SCOTT WARTHIN, PH.D., M.D., and CARL VERNON WELLER, M.S., M.D. Vol. IX, 1918-1919. Ann Arbor, Mich.

THIS volume is composed of six reprints of papers published by the authors, in conjunction with Herrmann and Roos, on the pathology of the acute lesions of the skin, ocular, respiratory and gastrointestinal tracts produced by mustard gas; also the general pathology, clinical pathology and treatment of mustard-gas poisoning and injuries and a bibliography of twenty-seven references to the domestic and foreign literature on this subject. Most of the work on the pathology of mustard-gas poisoning was conducted with experimental animals, while the reports on the clinical pathology and treatment are largely based upon work among gassed soldiers. That the subject is one of great interest and importance is well known, and the authors are to be congratulated for an excellent, comprehensive and well-executed research elucidating the manifold lesions produced by this dreadful substance. The results are clearly and briefly presented and the text greatly aided by a series of splendid photomicrographs. Inasmuch as the ultimate effects of gas-poisoning are of primary importance now during the period of reconstruction, it is hoped that the authors will contribute further on the subject in reference to the chronic and healed lesions.

J. A. K.

SURGICAL ASPECTS OF TYPHOID AND PARATYPHOID FEVERS. By A. E. WEBB-JOHNSON, D.S.O., M.B., PH.B., F.R.C.S., Consulting Surgeon, B.E.F., Hunterian Professor of Surgery and Assistant Surgeon to the Middlesex Hospital. Pp. 190, 28 illustrations, including 2 plates. London: Henry Frowde and Hodder & Stoughton, 1919.

COLONEL Webb-Johnson has presented not only an exceedingly interesting book historically, but one of great value to the surgeon. He had many opportunities for closely observing a large series of cases in this group of diseases during the present war, and he has utilized these opportunities to the best possible advantage. The "carrier" problem, one of extreme interest to the civilian community as well as to the Army is ably set forth. The role played by the spleen is also fully discussed.

This work is very acceptable to the medical profession at this time, for until the Hunterian Lecture delivered by the author in 1917 but scant literature was brought out on the subject since 1898, when W. W. Keen published his contribution to the subject.

The book makes most pleasing, instructive and entertaining reading. The subject-matter is well covered, and the book itself does great credit to the author as well as the publishers.

E. L. E.

AIDS TO SURGERY. By JOSEPH CUMMING, M.B., B.S., F.R.C.S., ENG., Surgeon to the Royal Free Hospital; Late Surgeon to the Cancer Hospital; Late Surgeon to the Victoria Hospital for Children, etc., and CECIL A. JOEL, M.S., LOND., F.R.C.S., Assistant Surgeon to the Royal Free Hospital. Fourth edition. Pp. 420. New York: William Wood & Co., 1919.

THE fact that this work has gone into the fourth edition is evidence that it is good. In this the last edition an endeavor has been made to incorporate all the latest advances in military surgery. This, however, has not been entirely accomplished, but a great deal of useful military surgery has been presented to the reader.

The book is one of the Student Series, and as such is a very admirable work. It is in no way meant as an exhaustive treatise on surgery, yet it is astonishingly comprehensive. It is written in a style that reads easily, and the subject-matter is arranged, grouped and subheaded in a manner to aid the student in grasping the subject-matter the most readily.

In a book of this size it is to be expected that much will be merely touched upon, but there is surprisingly little of this. All the non-essentials are left for the larger works; only the surgical meat is incorporated.

The work should be a popular one with students. E. L. E.

TRANSACTIONS OF THE AMERICAN SURGICAL ASSOCIATION. Edited by JOHN F. BINNIE, M.D., Recorder of the Association. Vol. XXXVI. Pp. 602. Philadelphia: William J. Dornan, Publisher.

THIS volume deals with many of the much-mooted questions of today, questions which have arisen from our experiences in the recent war. The surgical treatment of war wounds in general is given by C. L. Gibson, M.D., in an able article. Willis F. Manges outlines the methods of foreign-body localization. E. K. Dunham in his article on empyema brings out the great value of the Carrel-Dakin treatment. Georges Dehelly discusses the surgical closure of wounds. Reconstructive Surgery of the Head, Peripheral Nerve Repair, Transfusion, Laminectomy, the Report of the Committee on Fractures and thirty to thirty-five other articles of equal importance and interest are included in this compilation of excellent authors. Every article included is a good one and teaches the reader much that he has longed to know. This is especially true of the contributions on military hospitals and war surgery.

The reviewer can truthfully say that not in a long time has he had the opportunity of reading any work on surgery that can compare to this volume in the sustained interest created.

E. L. E.

LENZMANN'S MANUAL OF EMERGENCIES, MEDICAL, SURGICAL AND OBSTETRICAL, THEIR PATHOLOGY, DIAGNOSIS AND TREATMENT. By J. SNOWMA, M.D., M.R.C.P. London. Pp. 345. William Wood & Company, 1919.

THIS manual is based upon the English edition of Lenzmann's *Emergencies*, which appeared in 1914. It deals with the diagnosis, pathology and treatment of dangerous emergencies of sudden origin which threaten life, such as the emergencies of sudden origin in disease of the respiratory system; in disease of the heart; of the nervous system; of the gastro-intestinal tract; of the urinary organs; emergencies due to acute poisoning and obstetrical emergencies.

Without question the information given is of great value to all practitioners who are called upon to meet emergencies, and the book is thoroughly up to date and easy of reference. This last fact is what makes the book of particular value, inasmuch as in emergencies quick reference is essential. Needless to say, no medical subject can be treated exhaustively in this manner, but this the author does not pretend to do, and, on the other hand, he is to be commended on the practical value of all the chapters he has incorporated in this book.

C. N. S.

LICE AND THEIR MENACE TO MAN. By LIEUT. LLOYD, R.A.M.T.C. (T.), Chief Entomologist in Northern Rhodesia. With a Chapter on TRENCH FEVER. By MAJOR W. BYAM, R.A.M.C. Pp. 136. London: Henry Frowde, Oxford University Press and Hodder & Stoughton, Warwick Square, E. C., 1919.

ONE of the most urgent sanitary questions of the present and the future is the destruction and prevention of lice. This disgusting creature has been proved without a doubt to be the means of spreading typhus fever, relapsing fever and the so-called trench fever. We are familiar in this country most particularly with the head louse, children and old people being frequent sufferers. But we must not, however, close our eyes to the fact that serious diseases, even in this country, may be transmitted by the body louse. Lieut. Lloyd has written a very complete treatise, giving in minute detail the structure and life-history of the louse, its dissemination and the methods used in the various parts of the world to destroy it. The practices of the army in the fields are carefully described.

Major Byam gives a very interesting chapter on trench fever and the results of experiments carried out by the British Medical Corps.

Lieut. Lloyd, unfortunately, seems to go out of his way in pointing out that certain conclusions, which to his mind are erroneous, are put forth by American investigators. His references to other investigators of other countries is by name. His mention of American investigators is simply that they are American.

The book, however, is well written and covers the subject completely.

C. N. S.

CLINICAL MICROSCOPY AND CHEMISTRY. By F. A. MCJUNKIN, M.D., Professor of Pathology in the Marquette University School of Medicine. Pp. 470; illustrated. Philadelphia and London: W. B. Saunders Company, 1919.

AMID the bewildering mass of medical literature a clear-cut treatise on one of the phases of medical science is conspicuous and most welcome to the worker in that particular field. Such is the volume under review. Dr. McJunkin has covered clinical microscopy and chemistry correlating the material of other authors with his own in a manner that is most satisfactory. The descriptions of technic are clear and selection is made of the most practical methods. The book will prove valuable in all laboratories and to students of medicine.

Chapters are devoted to the examination of the blood, microscopically and chemically. Blood stains are covered fully. The chapter on serology includes the technic of the Wassermann test,

the Widal reaction, agglutinating tests, etc. A section is devoted to the sputum, serous fluids and exudates, another to the urine, another to gastric contents and another to feces.

The book closes with a long chapter on histological and autopsy technic, which correlates admirably the normal and pathological tissues with the materials commonly made the subject of clinical microscopic examinations.

The book is easy of reference, and its clearness of style commends it above many other books treating of the same subject.

C. N. S.

DIET IN HEALTH AND DISEASE. By JULIUS FRIEDENWALD, M.D., Professor of Gastro-enterology in the University of Maryland School of Medicine and College of Physicians and Surgeons, Baltimore; and JOHN RUHRÄH, M.D., Professor of Diseases of Children in the University of Maryland and College of Physicians and Surgeons, Baltimore. Fifth edition. Pp. 919. Philadelphia and London: W. B. Saunders Company, 1919.

A NEW edition of this standard work is welcome. In the opening chapters we find a consideration of the chemistry and physiology of digestion. Digestion and absorption of food, the composition of food, food requirements and the method of planning diets are thoroughly and interestingly discussed. In spite of our present imperfect knowledge of the subject more space might have been devoted to the vitamins.

The various classes of food, such as animal, vegetable, fruits and nuts, are described and analyzed and their nutritive value given. That important food, milk, is dealt with at considerable length. Due consideration is given to the salts. The mineral-containing foods are pointed out. Incidentally, in the several pages on alcohol the authors state their opinion that this substance is of undoubted value in medicine and that its use and abuse have been confused.

After chapters on concentration of food, cooking of food, food adulteration, etc., space is devoted to the feeding of infants and children. Much that is good is concentrated in these hundred pages. Other methods of feeding, such as rectal and duodenal, are not forgotten.

Having considered diet in a general way and sufficiently discussed the different foods as to their composition, digestibility and caloric value the question of diet in diseased conditions occupies the large part of the remainder of the book. Especially instructive is the section dealing with diseases in which diet is the primary factor. Later the dietetic management of surgical cases, army and navy rations, prison dietaries and hospital dietaries are dilated upon. There are thirty pages of recipes. Finally, the chemical composition

of American food materials taken from Atwater and Bryant's *Bulletin* and Locke's *Tables* are given.

Altogether, this standard work is a very complete and satisfactory one on diet. Playing, as it does, such an important and necessary part in so many conditions, diet should always be considered in the management of the sick. Indeed, it would not do many of us harm to question the diet of the apparently well, and Friedenwald and Ruhrah's book should act as a tonic to stimulate us in that direction.

A. G. M.

ROENTGEN DIAGNOSIS OF DISEASES OF THE HEAD. By DR. ARTHUR SCHÜLLER, Head of the Clinic for Nervous Diseases, Franz Joseph Ambulatorium, Vienna. Authorized translation by FRED F. STOCKING, M.D., M.R.C., with a foreword by ERNEST SACKS, M.D., Associate Professor of Surgery, Washington University. Approved for publication by the Surgeon-General, U. S. Army. Pp. 305; 97 illustrations. St. Louis: C. V. Mosby Co.

Most American neurologists and roentgenologists are familiar with Dr. Schüller's book, which made its appearance in Germany a few years ago, before the onset of the recent world conflict. It is not, therefore, a new book, but the English translation has recently been published. The publication of his book placed Schüller in the position of probably the greatest authority on the roentgen diagnosis of anomalies and pathological conditions of the skull and cranial contents. The work is a very important one and most instructive, and the translator is to be highly commended for his efforts to place the text in the English language. It has been done in a most admirable manner. Having been a student under Schüller, he was well fitted for the task. As this is probably the best and most comprehensive monograph extant upon roentgenology of the head, exclusive of the accessory sinuses, teeth, ear and orbit, it hardly needs further recommendation. To those familiar with the subject it is recognized as authoritative, and those who have known Schüller realize that he was a master of his subject. While the book deals particularly with the roentgen aspect, interest in it need not necessarily be confined to the roentgenologist's viewpoint, for it appeals to anyone from the general diagnostic standpoint.

The first chapter deals with the morphology of the normal skull in different races and at different ages. The second chapter discusses the anomalies in size, shape and contour of the skull, due to disturbances or abnormalities in skeletal development and growth. This subject is dealt with in a very thorough and comprehensive manner, based upon an unusually wide experience. This chapter also deals with changes in consequence of systemic diseases—cretinism, achondroplasia, Paget's disease, rickets and many rare

affections—and also conditions of inflammatory origin and tumors of the bones. Injuries do not receive as much attention as would be expected at this present time. The third chapter includes pathological conditions within the skull that can be demonstrated directly by the roentgenogram or indirectly through pressure, bone destruction, bone formation or secondary invasion of the accessory sinuses. A very thorough discussion is given to changes in the sella turcica from various causes. The appendix includes brief remarks relative to various conditions that may be determined in the accessory sinuses, teeth, ear and orbit.

H. K. P.

SURGICAL CLINICS OF CHICAGO. By NUMEROUS AUTHORS. Vol. III, No. 3. Pp. 243; 63 illustrations. Philadelphia and London: W. B. Saunders Company, April, 1919.

THIS number maintains the reputation of this important publication, which deserves its continued popularity. The subjects are so numerous and varied that it becomes impossible to even outline the contents of the volume. Andrews briefly but clearly elucidates his method of ligating and dividing the cystic duct in a cholecystectomy, after which he closed the abdominal wound without drainage. He also refers to four cases in which the use of the Parham-Martin band was probably responsible for non-union of fractures. Ochsner writes on the operative treatment of some fractures and on hare-lip, to which Brophy also devotes his attention. Davis offers an interesting modification or addition to the operation of capsulorrhaphy for recurrent dislocation of the patella. Thus throughout the number is crowded with brief and interesting reports of surgical cases by renowned surgeons, with many illustrations.

T. T. T.

PROGRESS OF MEDICAL SCIENCE

SURGERY

UNDER THE CHARGE OF

T. TURNER THOMAS, M.D.,

ASSOCIATE PROFESSOR OF APPLIED ANATOMY AND ASSOCIATE IN SURGERY IN THE
UNIVERSITY OF PENNSYLVANIA; SURGEON TO THE PHILADELPHIA GENERAL,
ST. AGNES AND NORTHEASTERN HOSPITALS.

The "Provocative" Wassermann Test.—POLLITZER and SPIEGEL (*Am. Jour. Syph.*, April, 1919, iii, 252) say that no one who has had a large experience with the Wassermann test would deny its great value for the clinician; but no one with any considerable experience would be willing to accept a single Wassermann report, in the absence of supporting clinical data, as conclusive evidence either for or against the presence of syphilitic infection. One of them can point to at least a score of cases of untreated syphilis with florid eruption in the secondary stage in which a laboratory reported the reaction negative; and this not from one laboratory, the quality of whose work would thereby be greatly impugned, but from many laboratories in different parts of the country. They concluded that the Wassermann test is so subject to errors of various kinds that dependence on a single reaction in a series of tests is not justified. In an uncured case a change from a negative to a positive reaction may happen to coincide with the "provocative" injection and a positive found after the injection may be the result of the normal increase in reagent without relation to the injection. In a series of about 150 cases of untreated syphilis of all kinds the writers did not find a single clear case of a provoked reaction, while the assumption of a cure in all cases is obviously untenable. In a series of cases temporarily negative selected as probably not cured, the "provocative" test failed to indicate the presence of syphilis, though the subsequent course of the cases proved that the syphilis was not cured. They regard the "provocative" arsphenamin injection as a useless and often misleading procedure.

A Survey of Wassermann Reactions Made in the Serological Laboratory of the City of Cleveland.—ECKER (*Am. Jour. Syph.*, April, 1919, iii, 260) says that of 9412 Wassermann tests made at the serological laboratory of the city of Cleveland, Ohio, during the last two years,

6475 were male cases and 2937 female cases. The percentage of positives among the males was 23.71 and among the females 24.99. The percentage of positives increased with advancing years, but decreased between the ages of forty-one and sixty. The percentage of positives among females between the ages of sixteen and twenty-five was considerably higher than that of the males of the same ages. The largest number of tests were made among the laboring classes of the city. With the exception of clerks and salesmen there was a larger percentage of positives among the married than among the single in the different occupations. The percentage of positives among housewives was 29.11. The incidence was considerably higher among the colored than the white race. The percentage of positives among the married colored was 46.89, while among the married white it was 27.48. The percentage of positives among the single whites was 25.21 and among the single colored 37.09.

Resuscitation Work in a Casualty Clearing Station.—CHARLES and SLADDEN (*British Med. Jour.*, April 5, 1919, p. 402) say the general lines of resuscitation treatment were followed: Warmth applied by hot air from a paraffin stove, ventilating over the patient into his blankets, and from hot-water bottles, was the first and most important element. To quench thirst by water a sweetened lemonade and other mild drinks were insistent needs and useful aids; it was necessary to prevent excess of drinking in many cases of shock and abdominal wounds in which vomiting was persistent. Morphine judiciously given, heroin in chest cases and camphor as a cardiac stimulant were all utilized when desirable. So far as possible morphine was not given in doses larger than $\frac{1}{4}$ grain nor more than once in twelve hours—exceptions to this general rule seldom had to be made. Intravenous injections were largely used in the worst cases. As a rule, blood transfusion was reserved for the postoperative stage when all bleeding points had been secured. Two methods were utilized: (1) The whole blood method, using the Vincent tube, with paraffined surface; and (2) a very simple citrate method—the latter more commonly. The citrate method was as follows: The blood was drawn from the donor by short curved glass cannula or alternatively by a wide hollow needle, and the flow directed into a sterile graduated measure containing 5 per cent. citrate solution in the proportion of 2 ounces for a pint of blood, 1 to 10. This gives finally a citrate percentage of just under 0.5 per cent., which was found to give a safe but not excessive margin against clotting. It is essential to ensure adequate admixture of citrate with blood either by stirring or agitation of the contents of the vessel. It was found convenient to stock this citrate solution ready autoclaved in 2-ounce (60 c.c.) quantities ready for use. If a hollow needle be used the internal diameter should be from 2 to 2.5 mm. and the length about 4 cm., and it is absolutely essential to have the needle very carefully and recently sharpened. On incision through the skin this is an advantage before inserting the needle. Should there be any doubt of the sharpness of the needle, or if the donor's vein is not well swollen, time is saved by exposing the vein and inserting the glass cannula; it was not found necessary to line either cannula or needle with paraffin. Care is necessary in adjusting pressure to donor's upper

arm, sufficiently but not too strongly, so that a brisk stream of blood is ensured. The citrated blood, kept warm at 40° C., was then run into the recipient's vein by means of a simple funnel, tube and glass cannula as used for saline infusions. The writers conclude that resuscitation methods such as have been developed during the war are of the utmost value in war surgery. It is evident that these methods will be equally applicable in the every-day surgery of accidental injuries and in obstetrics. Gum infusion is an advance on the infusion of normal saline and may enable a patient who has not lost blood excessively to be operated on successfully. It is not evident that the benefit due to gum can extend over more than a few hours. When hemorrhage is severe, blood transfusion is the only reliable treatment and should be given without delay. In such cases it is much superior to gum. In blood transfusion they found no great difference between whole blood and citrated blood. Previous to transfusion a blood-grouping test should be made in every case. If possible the donor should be of the same group as the recipient. They emphasize the need for the strictest surgical aseptic technic toward donor and recipient. The donor must be free from known general infections, such as syphilis or malaria, in so far as can be determined by inquiry.

Operative Treatment of Undescended or Maldescended Testis, with Special Reference to End-results.—COLEY (*Surg., Gynec. and Obst.*, 1919, xxviii, 452) says that in most cases the etiology points to a congenital origin, often influenced by the element of heredity and frequently associated, particularly in the double variety, with other developmental defects. The atrophy usually found in the undescended or maldescended testis is not the result of the malposition. The change in structure and the atrophy are merely coincident, being due to congenital causes. The question of the functional value of the undescended testis cannot be definitely answered in an individual case. It may be stated, however, as a general rule, that an undescended or maldescended testis, with which there is associated a marked atrophy, has little or no functional value. However, the author believes with Uffreduzzi that in a considerable number of cases of undescended testis spermatogenesis is retained. The ectopic testicle is practically always associated with an open vaginal process of peritoneum, *i. e.*, there is usually present a potential hernia. This vaginal process is almost invariably a congenital affair, for the reason that its position is entirely independent of the location of the testis. Torsion of the cord is more frequently observed in the undescended testis than in the normal testis. The undescended testis shows a greater tendency than the normal testis to malignant degeneration. Operation should be advocated in children and in adults. It is possible to cure the hernia in practically all cases, although the testis does not remain at the bottom of the scrotum several years after operation. The atrophied testicle is generally found to have retracted to midscrotum or in the region of the external ring, and in a position somewhat less liable to trauma than before operation. In none of the series of cases operated on at the Hospital for Ruptured and Crippled Children during the past twenty-nine years has malignant disease been known to develop as the result of the trauma incident to the operation. The author still believes

that the undescended testis should never be sacrificed in children and that the general tendency to remove the testis is greatly to be deprecated. Even if the testis be of little functional value it nevertheless is of great value in developing the male characteristics of the child. In adults it has an influence on the mentality and has a moral effect. Operation in the child should be postponed until he is ten to twelve years of age.

Continued Extension by Means of a New Extension Frame in the Bloodless Reduction of Congenital Dislocation of the Hip.—CHURCHMAN (*Surg., Gynec. and Obst.*, 1919, xxviii, 518) says that his method consists briefly in: Application of extension in the line of the legs as they rest in their deformed position; gradual abduction until the legs form with each other an angle of 180 degrees; when maximum abduction has been obtained, digital manipulation of the head of the femur, to drop them into place; maintenance throughout of rotation necessary to keep the toes pointing directly upward; gradual reduction of the maximum abduction until the legs form with each other an angle of about 35 degrees. Application of plaster cast from the waist to the knees; transmission of the body weight to the acetabula, through the heads of the femurs, by allowing the child to walk. If a favorable case in a young infant with well-developed acetabula is treated in this way, not only will the case be simplified by eliminating the violent manipulations hitherto used, but more accurate results will probably be obtained, because it will be found that the head can in this way be at will placed exactly where one wishes it to lie, and that if the position, by roentgenographs, is shown to be not entirely satisfactory, a change in the direction of the extension or rotation straps will make the desired correction.

THERAPEUTICS

UNDER THE CHARGE OF

SAMUEL W. LAMBERT, M.D.,

NEW YORK,

AND

CHARLES C. LEIB, M.D.,

ASSISTANT PROFESSOR OF PHARMACOLOGY, COLUMBIA UNIVERSITY.

A Note on Sodium Morrhuate in Tuberculosis.—By a process similar to that by which sodium gynocardate is obtained from chaulmoogra oil, ROGERS (*British Med. Jour.*, February 8, 1919, p. 147) made a preparation of the sodium salts of the unsaturated fatty acids of cod-liver oil which he terms "sodium morrhuate." It is used in the form of a sterile 3 per cent. aqueous solution, administered subcutaneously in gradually increasing doses two or three times a week. When the dose reaches an inconvenient size (2 c.c.) it is given by intravenous injection. Sodium morrhuate has been under trial for a year by the

writer and four other observers. From their observations, the author draws the following conclusions: In the doses recommended, sodium morrhuate is harmless in tuberculosis; at the same time, the fact that it causes febrile and local reactions necessitates caution in its use. Improvement in phthisical cases is seen in reduction and cessation of the fever, diminution of the expectoration and cough, and steady gain in weight, the last being a very marked feature. In addition, the tubercle bacilli in the sputum greatly decrease in number and may in time disappear. Moreover, they commonly show deficient acid staining and a granular appearance, indicating that they are actually being destroyed within the tissues. The author has also used sodium morrhuate in leprosy and a year's experience has shown it to be of great value in this disease. This supports the writer's view that there is nothing specific in the products of chaulmoogra oil in leprosy and that the sodium salts of the unsaturated fatty acids of the two oils act in some way on the coating of the acid-fast bacteria. As both tuberculosis and leprosy are produced by acid-fast bacilli, sodium gynocardate might be expected to exert a beneficial action in phthisis; however, in rare cases of leprosy, sodium gynocardate intravenously caused prolonged febrile reaction with temporary exacerbation of the disease so the author hesitated to use it in tuberculosis.

Inunction of Creosote in Pneumonia and Influenza.—WELLS (*British Med. Jour.*, April 19, 1919, p. 481) treated his cases of influenza by rest in bed, plenty of fresh air and the administration by mouth of 0.5 minim creosote shaken up with half an ounce of water. Very few cases treated in this way developed pneumonia. When signs of pneumonia appeared the axillary inunction of creosote (10 minims) was nearly always followed by its abortion. A second dose was rarely necessary. The patient was dressed in flannel and placed between blankets to avoid a chill after the sweating. The only disagreeable after-effect is a slight burning of the skin for a day or two. For children the creosote is diluted with soap liniment. Since 1898, the author has made frequent use of this method in pneumonia with almost unvarying success; he considers the results too constant to admit of the change in the patient's condition being merely a coincidence with the crisis occurring at the time of the administration of the treatment. He believes creosote administered by axillary inunction enters the blood stream through the lymphatics and is taken direct to the lung tissues by the pulmonary circulation; its diaphoretic action helps to relieve the hyperemia of the lung tissues and its antiseptic action is brought to bear directly on any germs that may be present in the air spaces of the lungs. When administered by mouth, the action of creosote is mainly that of a local antiseptic and sedative to the fauces, but its action is also felt by the upper air passages.

The Influenza Epidemic of 1918 in the American Expeditionary Forces in France and England.—MACNEAL gives a long and interesting account (*Arch. Int. Med.*, 1919, xxiii, 657) of the influenza epidemic in the A. E. F. in France which broke out in May, 1918. From August, 1918, on, the previously mild epidemic assumed a more malignant character, often leading to a fatal bronchopneumonia. At autopsy the

lungs presented a picture of malignant coalescing bronchopneumonia, frequently with hemorrhagic tracheobronchitis. The changes varied considerably with the chronicity of the disease and the nature of the secondary infections. In fulminant cases influenza bacilli in large numbers were found in the bronchi. The bacillus of Pfeiffer was the apparent cause of the epidemic but at most of the necropsies a mixture of bacteria was found in the respiratory tract. Blood cultures during life were usually negative but pneumococci or streptococci were found in some cases. Overwork, exposure to cold and wet, inadequate nourishment, etc., diminished the natural resistance to the disease and the contagion spread rapidly by distribution in the secretions of the nose and mouth, not only of the sick, but of "carriers" not suffering from the disease. The author considers vaccines of doubtful value; avoidance of contagion and general hygienic measures are advocated. Rest in bed, warmth and bodily comfort, promptly enforced at the onset of the disease, he considers the most important elements in the treatment. The author believes that the epidemic of influenza originated in France from the endemic influenza widely prevalent there and considers it probable that the large numbers of American soldiers in France, subjected to strange environmental conditions, furnished a fertile soil for the propagation of the disease.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Influenzal Croup.—REGAN and REGAN (*Am. Jour. Dis. Children*, June, 1919, No. 6, vol. xvii) call attention to the fact that during the past epidemic of influenza a number of cases of "influenzal croup" were seen in their work. The clinical course of the disease, the constant absence of membrane from the tonsils, the failure to respond to antitoxin and the uncertain effects of intubation were all suggestive of an etiology distinct from that of diphtheria. Bacteriological and pathological findings proved this to be the case. At first, however, the clinical resemblance to membranous croup was so close that many of the patients were admitted to the diphtheria wards under an incorrect diagnosis of laryngeal diphtheria. As a rule, the disease begins with the symptoms of influenza, and then after a period of from two to ten days the signs of croup appear. The subsequent course of the malady is similar to that of diphtheritic croup, and depends on the severity of the laryngeal involvement and on the presence or absence of a complicating pneumonia. It was common for the symptoms of laryngeal obstruction to progress to a point of impending asphyxia, during periods of spasm, and at such times there was marked retraction of the suprasternal fossa, of the epigastrium and the disappearance of the radial pulse during inspiration, noisy breathing, cyanosis of the

skin and mucous membrane, profuse sweating and extreme restlessness. In a small percentage of cases the attacks of asphyxiation increase in frequency and severity to such a degree that operative interference is required or death results. More commonly, however, under favorable conditions of treatment, the frequency and severity of the spasms diminish, and after from three to five days they disappear altogether. If a pneumonic complication exists, as is commonly the case, the symptoms of laryngeal stenosis usually dominate the clinical picture, the pneumonia occupying a place of secondary importance. Under such circumstances auscultation of the chest will fail to reveal the presence of a pulmonary consolidation, owing to diminished aëration, but percussion may bring out areas of dullness. Certain symptoms of influenzal croup differ from those found in laryngeal diphtheria. Thus the tonsils and larynx are free of membrane, the mucous membrane of the throat having a deep red, dry, glistening appearance from the moist appearance common in diphtheria. The mucosa of the mouth is parched, and in the early stages of the disease the tongue is dry and feels hot to the touch. Auscultation of the chest reveals the presence of a considerable number of sibilant and sonorous rales. In two instances of the authors' series the disease was complicated by pregnancy. In one case both the mother and the child died and in the other the mother recovered and there was no obvious effect in the child. Influenzal croup was most frequent in children between the ages of three and ten, boys being more often affected than girls. In no instance was there a history of exposure to diphtheria, while in 14 of the 20 cases of this series there was a definite history of exposure to influenza; in most all to some one ill with the disease in the immediate family. Often the connection between the two conditions was extremely striking. Death occurred in 5 of the series. The mortality was rather low, inasmuch as many of the patients presented symptoms of extreme laryngeal stenosis, and all but 3 had pneumonia. The causative agent of this particular form of croup is not the diphtheria bacillus. Cultures taken from the nasopharynx, the tonsils and the sputum during life and from the larynx, trachea and lungs after death all uniformly failed to show the Klebs-Loeffler bacillus. The bacterial flora found were very similar to that noted in general among influenzal cases. Thus, in the nasopharynx culture there was a predominance of the Pfeiffer bacillus, pneumococcus and Micrococcus catarrhalis. In the cultures from the sputum streptopneumococci and Pfeiffer bacillus were most common, with pneumococci and staphylococci in less numbers. In cultures taken postmortem from the larynx and trachea staphylococci were most common. Pfeiffer bacilli and pneumococci in somewhat less numbers. The blood picture varied. Leukopenia occurred, but was very inconstant. A moderate leukocytosis was most constant, as the frequency of pneumonia would lead one to expect. Blood cultures in one instance showed streptococci. Four patients came to necropsy. In 2 of the 4 the gross pathology was very similar. In each of these 2 cases there was an extensive, massive bronchopneumonia in the lower lobes of both lungs, with ecchymotic spots under the pleura, together with a severe grade of edema of the unconsolidated tissues. The larynx was intensely congested, the mucous membrane of the epiglottis swollen and edematous, likewise

the mucosa around the true and the false cords. The congestion and also the edema to a lesser extent extended downward to the trachea and the bronchi. Scattered here and there over the surface of the mucous membrane were a number of minute, whitish plaques, measuring about a half an inch in diameter and easily removed from the mucosa. The spleen appeared large and congested in both cases. In the third case there was some extensive bronchopneumonia, with severe congestion and some edema of the larynx, but without any exudate on the membrane. In a fourth case only the larynx was examined; in this instance the larynx appeared the same as in the last-mentioned necropsy. Microscopic section of the larynx and trachea showed definite pathological changes. The surface epithelium of the mucosa was intact and there was no evidence of film formation, showing its dissimilarity to diphtheritic laryngitis. The bloodvessels of the mucosa and submucosa were markedly dilated, and there was an extensive exudation of polynuclear cells, lymphocytes and serum into the surrounding tissues. The thickening of the mucosa and submucosa was greatly increased by the infiltration of its tissue and the dilatation of its bloodvessels. In the treatment of the malady it was found usually best to administer diphtheria antitoxin, owing to the difficulty of making a definite diagnosis from laryngeal diphtheria. Direct laryngoscopic examination presents many difficulties in patients who are irrational, difficult to control and dyspneic. Then again, cultures required time for examination. The treatment that proved exceedingly effective was the use of steam inhalations, carried out in a small room, in which the saturation of the atmosphere with vapor could be carefully controlled. The results were very satisfactory, and there is little doubt that a number of intubations were thus avoided. In addition to steam inhalations, flaxseed poultices were applied to the neck; morphin sulphate and atropin sulphate were given in doses proportionate to the age, to control the spasms and the restlessness. Intubation was required in 6 patients, one being an adult. The immediate effect of the introduction of the tube in most instances was to make the patient worse, and extubation had to be immediately performed in 3 cases. The harmful effect seemed to be due to the fact that the pressure of the tube increased the congestion existing in the mucous membrane below, further adding to the mechanical obstruction. Antipneumococcic serum was used in one case, with very beneficial effects. It well deserves a trial, especially as the causative agent is often associated with the pneumococcus. This seemed to be the case more commonly in children. In adults the infection is often of a somewhat different type, the streptococcus and the staphylococcus predominating. In the former instance a polyvalent streptococcic serum is suggested as well worth a trial. In cases in which the predominant infection is streptopneumococcic a combined polyvalent serum is recommended. Diphtheria antitoxin seemed to have no effect on the local process.

Fat Metabolism of Infants and Young Children: II.—HOLT, COURTENAY and FALES (*Am. Jour. Dis. Children*, June, 1919, No. 6, vol. xvii) continue their observations on fat metabolism. In this article are collected the results of analysis of 128 stools of 77 infants, whose

ages ranged from two to eighteen months, fed on modifications of cows' milk. The average fat percentage of the dried weight of normal stools was 36.2. The hard, constipated stools showed no variation from this figure. In the stools not quite normal in appearance the average fat percentage of dried weight was much higher, reaching an average of 40.7 per cent. The soap percentage of total fat was very high in both normal and constipated stools, averaging, respectively, 72.8 and 73.8 per cent. As the stool became less normal in appearance the soap fat diminished rapidly and averaged in the loose stool only 30.6 per cent. of the total fat, in the diarrheal stool 12.4 per cent. and in those of severe diarrhea only 8.8 per cent. of the total fat. The neutral fat was less than 10 per cent. of the total fat in normal and constipated stools. It increased as the soap fat diminished and in diarrheal conditions made up about 60 per cent. of the total fat in the stool. The free fatty acids constituted about 17 per cent. of the total fat of normal and of constipated stools. It was increased somewhat as the stools became less like the normal, and in the diarrheal stools was over 30 per cent. of the total fat in the stool. No definite relation was shown between the daily fat intake and the percentage of fat and the distribution of fat in the stool. The average percentage of fat retained with normal stools was 91.3 per cent. of the intake. The retention was but little lower when the stools were somewhat harder or softer than normal, or were not homogeneous, or contained more or less mucus without being distinctly watery. As the water in the stools increased the percentage of retention dropped markedly, reaching in severe diarrhea 58.4 per cent. of the intake. There was no striking relation between the fat intake and the percentage of the intake retained, except when the intake was abnormally low.

Chorea.—STEVENS (*Am. Med.*, April, 1919) objects to the characterization of this disease as "infectious chorea." He admits that in a limited number of cases death has quickly supervened upon an attack in which choreiform symptoms have been observed, but that these have been of different kinds in different cases, and he says that it cannot be said that any specific organisms of a bacterial nature is characteristic of the various cases. These are not the typical form of chorea. He thinks that this form is probably some undescribed affection or infection, in which the choreiform manifestations are a part of the clinical picture. He objects to the designation of "chorea minor" and "chorea major" because the difference lies only in a difference of severity. As the principal features of chorea, he claims that there always is a disturbance of motility; that it attacks principally children between the ages of five and fifteen, although it may continue for many years or for a lifetime; that the disturbances of motility are spontaneous or of coördination; that these disturbances of motility are most commonly manifested either as movements of the upper extremities or of the head and face. He says that in severe cases the disturbances extend to the trunk and lower extremities and that in sleep the movements are usually quieted. He has developed the following hypothesis in the search for the predisposing cause: "The principal predisposing cause of the typical form of chorea is found in the unsymmetrical development of different parts of the cerebrum and absence

of exact conformity of growth of the cranium, especially at the anterior portion, inducing a slight pressure on the cerebrum at a point or points controlling the movements which are involved in the choreic disturbances."

Pyloric Stenosis in Infancy.—WALL (*Arch. Pediat.*, 1919, xxxvi, 193), in discussing the conflict of opinion as to the production of stenosis of the pylorus, says that it requires rather a vivid imagination to attribute a great, hard pyloric mass of muscle tissue, perhaps the size of an olive, to the effect of any species of gymnastic exercise which may have been indulged in throughout a brief period of three or four weeks. It would seem more plausible to look upon the hypertrophic stenosis as a developmental aberration such as we find in the lingual frenum, or labial frenum, or in the redundant prepuce of the male infant. Undoubtedly the element of spasm comes into play at a certain stage of a preëxistent hypertrophy, not only spasm of the pyloric sphincter, but overaction of the stomach circular fibers as demonstrated by the peristaltic waves. He has been able to discover but one developmental feature which in the intricacies of embryonic growth may have a bearing upon the conditions productive of hyperplasia of the circular muscle at the pylorus—namely, a temporary obturation of the lumen of the duodenum which is apparently a normal stage of evolution in the fetus at a very early period of growth. Well-marked tumors of pyloric hypertrophy have been reported in the newborn as well as in infants born prematurely, which adds emphasis to the view that hypertrophic stenosis is a congenital defect.

The Treatment of Pulmonary Tuberculosis in Children by Artificial Pneumothorax.—STOLKIND (*British Jour. Children's Dis.*, January-March, 1919, Nos. 181-183, vol. xvi) reports seven cases. He says that the ideal case for artificial pneumothorax is one of advanced pulmonary tuberculosis or the so-called second or third stage, with destructive or ulcerative one-sided disease, in which the other lung is, clinically at least, normal. Such typical cases of advanced and progressive pulmonary tuberculosis, in which only one lung is diseased and the other clinically healthy, are rare. In the majority of cases it is found that the other lung is also diseased more or less. In such case pneumothorax treatment is employed if the disease in the other lung is inactive or chronic and quiescent. If extensive chronic lesions in both lungs are found, pneumothorax must be performed in the most diseased lung first. Afterward, if it is necessary and there is considerable improvement, the gas can be allowed to become absorbed or it may be pumped out, and then a pneumothorax can be performed on the other lung. This treatment is also used in cases in which the disease is not much advanced or the first stage of pulmonary tuberculosis, if the process, in spite of proper treatment by other means, advances and especially if it progresses rapidly, or if there are symptoms of toxemia. As there is at present no sure means of stopping hemorrhage, pneumothorax is indicated in cases with recurrent hemoptysis, and if the hemorrhage is severe or cannot be otherwise arrested. The lung from which the bleeding comes should be recognized and completely compressed, for which purpose 2000 to 3000 c.c. of gas are introduced.

Another indication is in cases of acute and progressive pulmonary tuberculosis or acute tuberculous pneumonia or bronchopneumonia. Other indications are pulmonary tuberculosis with effusions—either hemothorax, serous or suppurative pleurisy, spontaneous pneumothorax and sero- or pyopneumothorax. In carcinomatous pleurisy artificial pneumothorax is beneficial in relieving the pain. Pleural adhesions are not a contra-indication, but may prevent the production of a pneumothorax or a complete collapse of the diseased lung. Pneumothorax treatment is contra-indicated in cases of pulmonary tuberculosis complicated by other severe disease, such as diseases of the circulatory system, liver, kidney or severe diabetes and emphysema. No more than 500 c.c. should be introduced at one time and radioscopy should be used as a guide, both as to the extent of the initial introduction and as to the necessity of a refill. In children anesthetics should be used when the treatment is given. The most frequent complications are subcutaneous emphysema and pleural effusions. The emphysema is harmless and disappears in a few days. The pleural effusions may appear at intervals ranging from weeks to months after introducing the gas. It is mostly due to infection which is chiefly tuberculous. The improvement which is often observed in phthisis after the occurrence of pleural effusion is due not only to better rest and immobilization of the compressed lung, but probably also to the serobiological influence of the exudate, which contains many antibodies or hemolytic and bactericidal complements.

Conditions Which Affect the Occurrence of Rectal Diseases in Infancy and Childhood.—LANDSMAN (*Med. Rec.*, 1919, xcv, 1089). To begin with we must not lose sight of the fact that the rectum is in intimate contact with the bones which form the posterior wall of the pelvis; hence, any difference in their shapes must be marked by a corresponding difference in the curves of the rectum. An examination of the infantile sacrum shows it to be relatively flat, shallow and less curved than that of the adult, while the coccyx is soft, yielding and its joints more freely movable. In agreement with this the rectum would acquire a tendency to become more straight in its course and direction, and to that extent to lose the essential support to which the shape of the bones contribute to such a marked degree. In accordance with the principles of mechanics, force applied on an object through a vertical axis produces a greater effect than when exerted through one which is curved. This offers a reasonable explanation of the frequency of prolapse of the bowel in children. Congenital defects are mostly dependent upon failure of the two parts which form the embryological rectum, the caudal extremity of the hind gut derived from the endoderm and the proctoderm derived from the invaginated ectoderm to unite properly. Other defects are due to failure of fusion or absorption connected with the cloaca. When we turn our attention to the problem of the functional activity of the organs as they affect rectal disease in the infant and young child we learn there are conditions which produce varying results at different age periods. Defecation, so far as it applies to infancy and young childhood, is an involuntary act, the resultant of automatic function which proceeds in a normal and orderly manner as long as there is no interruption in the reflex arc which carries

the impulse. Such is not the case in adults in whom the expulsion of intestinal contents is generally postponed to a convenient time. Hemorrhoids are rare in children. Rectal diseases occur with varying frequency in childhood and adult life; their presence or absence is not due to chance, but depends upon well-defined variations in the anatomy of the parts, the functional activity of the organs and the environment of the individual.

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

Labor Complicated by Uterine Inertia.—TITUS (*Jour. Am. Med. Assn.*, September 14, 1918) draws attention to the difficulty of classifying cases of uterine inertia because the element of time alone is not sufficient to establish a classification. One must take into consideration the type of patient and what would naturally be expected from a person of the particular type. The effort to make a distinction between primary and secondary inertia is of very doubtful value. But there is a difference between inertia and exhaustion. Inertia uteri is often due to inherent fault or lack in the muscle and nerves of the uterus, while exhaustion follows a long continued effort against an obstacle. The prophylactic treatment of the two is evidently different for while little or nothing can be done to prevent uterine inertia such obstacles as face presentation, contracted pelvis or posterior occipit can be recognized and thus exhaustion prevented. Inertia is usually apparent in the first stage of labor. Those who are below par physically from any cause endure the nagging pains of the first stage of labor very poorly. Oftentimes the patient becomes entirely unreasonable, demanding instant relief and exciting great apprehension in the minds of those about her. Even though the membranes be not ruptured a greatly prolonged first stage may lead to exhaustion through lack of sleep and lowering of the power of resistance. When the membranes are ruptured the condition may readily become serious. In 76 cases of inertia of the uterus 21, or 26 per cent., seemed to be due to the fact that the membranes had ruptured before labor pains began. The fact that the membranes ruptured early does not inevitably mean inertia for many patients have strong labor pains and rapid delivery following premature rupture of the membranes. If, however, the membranes have been ruptured for some time it is more than probable that interference will become necessary. A rise of temperature on the part of the mother with increased pulse-rate or rapid, irregular or very slow fetal heart-beat, with or without the passage of meconium, show that the fetus is in danger. Interference may mean incision of the cervix, damaging pressure from forceps, laceration, hemorrhage and liability to infection. If the patient can be carried on into the second stage of labor whether the membranes

be ruptured or not, it is much more feasible to meet the various indications. Repeated vaginal examinations during prolonged labor become a source of especial danger through infection. Some urge that examinations be made by rectum instead of through the vagina. Early delivery by forceps may be advisable even though serious symptoms have not appeared, for it is fair to assume that inertia in the first stage of labor indicates a possible similar condition in the second. Unfortunately, in these cases the patient often becomes so fatigued during the first stage that in the second stage she is unable to bring her abdominal muscles into play. Of the cases observed 21, or 27.6 per cent., followed rupture of the membranes before labor began, while in 3 cases membranes ruptured soon after the beginning of the pains. Inertia occurred in three patients who had been observed in their first delivery and again in their second. The oldest primiparæ were thirty-nine years of age and the youngest nineteen, while the average age in primiparæ was twenty-seven years. The oldest multipara was forty-two, the youngest twenty, the average age in this class was thirty-one years. There was one primiparous woman under twenty; 1 between twenty and thirty and 16 past thirty years of age. There were 7 multipara between twenty and thirty; a total of 58 were primipara; 17 were multiparas while the parity of one is not recorded. Of the multipara 9 were in second labor; 1 in the third; 2 in the fourth; 2 in the sixth; 1 in the seventh; 1 in the eighth and 1 in the eleventh. Among these using morphin-scopolamin inertia was exceedingly common. In the first stage of labor 12 cases required interference, while 41 went into a second stage before it became necessary to give assistance and 23 patients delivered themselves spontaneously, a percentage of 15.7, 53.9 and 30.2 respectively. The longest first stage of labor in the primipara was 174 hours; the shortest seven hours; the average time 38.3 hours, while among multipara the longest stage was 96 hours; the shortest eight and the average 34.3 hours. It is difficult to give exact figures concerning the second stage, and in some cases birth took place so rapidly that there was practically no second stage. The longest was eight and one-half hours in the primipara and four and one-half hours in the multipara. To state that a patient was allowed to continue eight and one-half hours in the second stage may be somewhat surprising, but it must be explained that there was some progress, although slow, throughout this time and no untoward symptoms developed, while at the same time the patient was being sharply watched. When interference developed during the first stage it was multiple incisions of the cervix. Interference during the first stage consisted in multiple incisions in the cervix, followed by forceps delivery in 8 cases. Vaginal Cesarean section once, Braxton-Hicks; version later completed by extraction once; craniotomy on a dead child once and the introduction of a bougie once. Abdominal Cesarean section has not been found necessary and was not considered safe after the patient had been long in labor, especially with ruptured membranes unless the extraperitoneal type of section is employed. Bags were not used although they might have been at times of great value. Forceps were used in the second stage 41 times, and of these patients 16, or 21 per cent., developed postpartum hemorrhage of more or less serious degree. In the first stage interference became necessary six times and twice in the second on

account of exhaustion of the mother, as shown by a rise in the pulse to 110 or more and a temperature of 100.5° or more. Once in the first stage interference was practised on account of mitral stenosis combined with evident distress on the part of the infant. Twice in the first stage and ten times in the second. In the second stage interference was necessary—17 times on account of undue prolongation without progress. Twice because of posterior occipito positions; twice because of heart lesions in the mother. There were no maternal deaths but five infants were born dead, or so deeply asphyxiated that they could not be revived. One of these dead infants was macerated. Two infants died within the first few days of life with the symptoms of intracranial hemorrhage. The inertia was apparently due to premature or early rupture of the membranes in 24 cases; the artificial induction of labor in 2 cases; physical debility from heart lesions in two; syphilis in one and tuberculosis in one; a twin pregnancy was responsible once, while multiparity seemed to be the factor in a few indefinite cases. Four cases had posterior rotation of the occiput in labor. The morbidity in these patients has not been thoroughly worked out, but seven showed a seriously febrile puerperium, although all recovered. In 1 case of this group there had been innumerable examinations by a midwife and in another a physician outside of the hospital had attempted to deliver by forceps. In 1 case the placenta had been removed manually after hemorrhage during the third stage. Puerperal psychosis occurred in two patients with subsequent recovery in both instances. In 6 cases there was retention of the placenta, three of these being due to hour-glass contraction of the uterus. Pituitrin extract given to the second stage produced hour-glass contraction of the uterus. The writer states that he finds very little if any use for pituitrin in his practice. In the first stage of labor it has certainly no place. When given during the second stage the writer has 3 cases of hour-glass contraction with retained placenta as the result of giving pituitrin during the second stage. The best time for its administration is after the expulsion of the placenta when the physician wishes to control the relaxation of the uterus and tendency to hemorrhage. Here it comes into comparison with ergot and it is thought to be much more prompt and efficient than pituitrin extract now given extensively by midwives. The writer insists upon an established distinction between uterine inertia and exhaustion and especially is this valuable in the selection of treatment. True inertia begins in the first stage of labor and with unruptured membranes all that is necessary is mild stimulants alternating with narcotics to produce sleep. If the membranes are ruptured and elevation of temperature or pulse is present any interference must be practised as soon as possible. Frequent vaginal examinations are especially dangerous in these cases and rectal examinations should be substituted in their place. Prompt rupture of the amniotic sac is a common cause of inertia in a patient otherwise well and strong, whereas constitutional defects from distention of the uterus by twins, hydramnios from frequent pregnancies are also important etiologic factors. Retention of the placenta, with or without hour-glass contraction of the uterus, is a common result of inertia extending into the third stage and hemorrhage is likely to occur during and after the placental stage.

Labor Complicated by Rupture and Inversion of the Uterus.—BRANDEAU (*Jour. arch. mens. de obst. et de gynec.*, 1917, vi, p. 195) records the case of a patient, aged thirty-two years, in her seventh labor. The first five were normal; the sixth a difficult instrumental delivery. At the end of the seventh pregnancy there was a spontaneous rupture of the uterus, after which laparotomy was immediately done. The fetus was among the loops of small intestine and easily extracted. The uterus was inverted and the placenta outside the wound and hysterectomy was performed. On examining the removed uterus it was completely inverted above the tear, so that the internal surface became the external and the peritoneal face was internal. The tubes and round ligaments had penetrated through the rupture and become internal. The rupture was on the left side nearer the posterior than the anterior face. Microscopic examination of the tissues at the tear showed the rent extended through cicatricial tissue in the midst of which were some necrosed muscular fibers. The internal os was also obliterated. The patient made a good recovery. The fact that the patient had a previous difficult labor and probably rupture of the lower segment would account for the rupture occurring in cicatricial tissue. This tissue was only about 1 mm. thick, and the very first beginnings of labor were sufficient to tear it. It is very difficult to account for the practical obliteration of the internal os. The placenta was inserted about 2 cm. above the tear where the uterine wall was exceedingly thin. That portion of the uterus above the tear was inverted and this probably arose from uterine inertia, which was very marked in the case.

The Teaching of Obstetrics.—In the *British Medical Journal*, February 15, 1919, is discussed a discussion which took place at the Royal University of Medicine on the teaching of obstetrics. It has been found impracticable to separate the teaching of obstetrics from that of gynecology. The preventive side of these branches of science was largely in evidence in the teaching. It was proposed to have the teaching hospital unit composed of a complete maternity center, a complete gynecological center and a child's welfare center. Such an arrangement would give the students a comprehensive idea of these allied branches of medicine. It would also be of advantage if the student were left to feel that he had a duty to the community in his work in these various departments. It was proposed by Fairbairn that the care of the infant up to nine months, or a year, belonged properly to the obstetrician. This was denied by some who held that, theoretically, the child should be in charge of the pediatrician from its birth. If this is impracticable the usual custom might prevail of having the infant pass from the care of the obstetrician when the mother had recovered fully from her confinement. It is of the greatest importance that pregnant women should receive thorough care. Even in toxemic conditions if the patient be carried safely through pregnancy there is no good reason to fear that the child may not grow up to be healthy. In proportion as the pregnant woman receives careful attention eclampsia will grow less frequent and such serious operations to secure a successful birth will become more rare. It must still be remembered that such care will not prevent the occurrence of adherent placenta or placenta

previa. It is of the utmost importance that obstetrics be considered a major subject in the medical curriculum. A six months course is the least possible preparation which should be given to this important branch. The students should also have a practical knowledge and they should be taught by senior teachers and not by junior and assistant members of the staff. The idea of whole time teachers is attractive, but the value of this proposal is open to question. To be successful large salaries must be paid. There is also the disadvantage that a whole time teacher might not have experience in private practice. No one can teach obstetrics successfully who is not continually engaged in clinical work among actual patients. The teaching department in obstetrics must also be a center of research. The routine work in such a department should be done by the junior member of the staff. The function of the chief would be to inspire, suggest and guide. In the very important problem in addition to what may be suggested for the improvement of obstetric teaching it must not be forgotten that the better education and control of midwives should receive attention.

The Teaching of Obstetrics and Gynecology to Medical Students.—GRIFFITH (*British Med. Jour.*, February 8, 1919) emphasizes the importance of a thorough training in obstetrics for medical students. He believes that gynecology is so intimately bound up with obstetrics that the subjects cannot be separated in teaching. He emphasizes the importance of preventive gynecology as distinguished from advanced and operative work. The obstetrical anatomy of the pelvis must be taught by the obstetrician, and this should be the gross anatomy which should be accurately given to the student. Physiology of the generative organs is also of great importance. Pregnancy, later the puerperal period and the pathology of obstetrics are the other subjects which should complete the course. Under pathology of labor he would include the treatment of obstetrical complications and only major operations, and also when the obstetrician must rely largely upon his own efforts. As regards methods of teaching, demonstration lectures, laboratory, museum and postmortem work, chemical work and teaching in wards and out-patient departments are the methods employed. The long and wearisome course of lectures which formerly was thought important is not considered the best method. Good lectures, well illustrated by personal experience, are of great value to advanced students who have already been grounded in the principles of the subject and have begun to obtain some experience of their own. Demonstration lectures, well illustrated with quizzes, are excellent. It is suggested that men on the back rows of benches be quizzed whose modesty or fear of quizzing has led them to take a back seat. Lectures and quizzes are better than textbooks, for they give the lecturer the opportunity of emphasizing and repeating points of fundamental importance and illustrating them from his own experience. The obstetrical anatomy of the pelvis and its contents, menstruation, the anatomy of pregnancy, labor and the puerperal period and the mechanism of labor, can all be taught to advantage in this way. The mechanism of labor should be taught with the fetus and not with the fetal skull only. The writer states that he does not know of any mannikin which is sufficiently flexible. The remaining subjects should be taught by demonstration lectures, accom-

panying clinical work in the wards and out-patient rooms. Out-patient obstetrical work should embrace the attendance of students on patients in their own homes and the attendance by pregnant women in the out-patient department of the hospital. The first is of value to the students, not only from the purely obstetric experience, but also from the knowledge which it gives of the domestic affairs and troubles which patients may have and in which the physician may do much to render assistance. The student should be held personally responsible for the history and examination of the patients. He should pay especial attention to obstetric diagnosis, including the condition of the breasts, and he will examine the patient for evidences of infection. He should be especially impressed with the value of a systematic examination of all women in advanced pregnancy. In some instances there is advantage in teaching at the bedside and in the delivery rooms mixed classes of students and postgraduates, together with midwives and nurses. In this way the students saw how little they knew of nursing and the nurses were impressed with the difference between their own instruction and that given to physicians.

Postmortem Cesarean Section Following Death from Bronchopneumonia and Influenza.—HEPPNER (*Jour. Am. Med. Assn.*, March 8, 1919) reports the case of a patient admitted to the hospital in the third labor. She was moribund, markedly cyanotic and profoundly toxic. She had been sick for six days before coming to the hospital and had a moderate bilateral basal bronchopneumonia. The fundus was 3 cm. above the umbilicus. The fetal heart sound was easily heard and about normal in rate. Permission could not be obtained for delivery by section, so it was determined to perform postmortem section at the moment of death. Between three and four hours after delivery the woman died. Fetal heart sounds were becoming less audible and for the last fifteen minutes were so feeble they could not be heard with a stethoscope. As soon as it was certain that death had occurred section was done. The child was found to be toxic and feeble, but was easily resuscitated and cried. It weighed over three pounds and five ounces, and was not at the full term. The child survived for twenty-five days, then dying of croupous pneumonia, with pleurisy. Microscopic examination of the child's lungs showed many alveoli with fibrin and foci of round-celled infiltration in the smaller bronchioles. These were areas of necrosis. There was an inflammatory deposit on the pleuræ. The time elapsing after the mother's death before the birth of the child was one and a half minutes.

The Heart of the Pregnant Woman.—BURCKHARDT (*Am. Jour. Obst.*, December, 1918) calls attention to the importance of taking a very minute history in cases of pregnancy. When foci of infection are found the physician should be especially careful in examining a pregnant patient, that he may not overlook some serious condition of the heart. In the toxemia of pregnancy, pathological conditions of the heart muscle are not infrequent, and at times valvular lesions may also develop. The pregnant patients who have abnormality of the thyroid, disturbances in the circulation are very common. It is of great importance in the case of a pregnant woman having abnormal heart condition

that compensation should be maintained. A careful general examination of the patient is necessary to determine whether this is present or absent. Low blood-pressure is of importance as indicating the possible failure in the action of the heart. In pregnant patients whose compensation is failing and when a well-defined heart lesion is present a very strict hygiene should be maintained. The least sense of fatigue is to be avoided, and if the patient cannot take exercise she should have massage until outdoor exercise can be maintained. Blood-pressure readings are of considerable value in determining the condition of the patient. Offending tonsils or teeth should be removed and the pregnant condition of the patient is no contra-indication.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA,

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Comparative Physiology of the Corpus Luteum.—In recent years some very interesting facts have been observed by veterinarians on the influence of the corpus luteum on sterility and abortion in the cow, and it has occurred to OCHSNER (*Illinois Med. Jour.*, 1919, xxxv, 225) that this data might be of great value in solving some of the similar problems in the human female. It has been observed, for instance, that if a false corpus luteum remains unabsorbed in either ovary of a cow she does not come in heat, a condition which corresponds to amenorrhea in woman, and so long as the cow does not come in heat she, of course, remains sterile. On the other hand, as soon as the false corpus luteum is absorbed normally or is expressed manually by the operating hand of the veterinarian the phenomenon known as heat develops within twenty-four hours. This observation has been made so many times by a sufficient number of highly trained, experienced veterinarians that in the minds of the veterinary fraternity it is no longer a debatable question. The author has had a number of patients with premature menopause who gave the history of having suddenly stopped menstruating because of a severe chilling during a menstrual period and who have never menstruated since, and another considerable number of patients who, following a severe chilling or illness during a menstrual period, menstruated only at intervals varying from several months to several years, who have had the distressing symptoms of artificial menopause, whom he today would laparotomize, carefully examine the ovaries of, and if an unabsorbed corpus luteum were found excise the same, with the hope of relieving their symptoms, reëstablishing men-

struation and curing their sterility. Veterinary surgeons have also made another very important discovery: Sometimes in expressing what they consider a false corpus luteum they have actually expressed or ruptured a true corpus luteum, in which instance one of two things has invariably happened: either the cow has bled to death in a very short time or she has aborted within from twenty-four to thirty-six hours. This observation on the cow throws very interesting light on two somewhat obscure problems in gynecological surgery, namely, the problem of abortion and the frequent finding of blood in the peritoneal cavity, which so frequently has been ascribed to ruptured extra-uterine pregnancy, but in which on careful examination no placental tissue has been found microscopically. The experience of veterinary surgeons, as well as Ochsner's experience in operating on pregnant women, leads him to believe that abortions following abdominal trauma are caused by injuries to the true corpus luteum and not to traumatism of the uterus itself, and that in operating upon pregnant women the important precaution is to avoid traumatism of the ovary containing the true corpus luteum if one wishes to avoid interruption of pregnancy. He has operated on a goodly number of pregnant women in almost every stage of pregnancy for a variety of abdominal conditions, such as intestinal obstruction, hernia, appendicitis, gall-stones and even fibroids of the uterus, without ever having caused an abortion, and he believes that this has been possible because he has always been very gentle with the ovaries at the time of such operations, not because he has known the fact that injury of the true corpus luteum would produce abortion, but because he has made it an invariable rule to treat all intra-abdominal organs with the greatest care and consideration.

The Action of Viburnum Prunifolium.—A review of the old clinical literature regarding the drugs efficient in the prevention of threatened abortion would lead the reader to believe that in the preparations of viburnum prunifolium there is available an unfailing remedy, one which quiets the uterus if that organ is stimulated to an abnormal degree of activity at an inopportune moment. The study of the action of certain proprietary remedies, one of the active principles of which was supposed to be derived from viburnum prunifolium, led HAGER and BECHT (*Jour. Pharm. and Exper. Ther.*, 1919, xiii, 61) to test the action of the latter drug also. The results of this investigation indicate that the effect produced on the uterus by alcoholic extracts and decoctions of viburnum bark are of little consequence in modifying the nature of the uterine activity, no uniform pharmacological effect can be ascribed to the drug, for while a stimulation may seem evident at one time a similar dose under the same conditions produces an apparent inhibition or no perceptible change whatever. As compared with drugs known to have a specific action on the uterine contractions, such as pilocarpin and pituitary extract in case of pregnant uterus the effect is negligible. The change in the contractions of the uterus which sometimes occur on the addition of an extract of the viburnum bark are so slight that the changes may be explained as having been produced reflexly through manipulations of the animal during injection or by the alcohol which holds the drug in solution. It is quite evident that the uterus of animals rendered unconscious by high section responds

to the intravenous injection of alcohol and a temporary inhibition or stimulation of the uterus is produced. As far as can be ascertained from the use of laboratory animals, no specific action on the uterus can be ascribed to preparations of the bark of *viburnum prunifolium*.

Factors of Safety in Hysterectomy.—In a series of 551 operations for hysterectomy performed by GUTHRIE (*Jour. Indiana State Med. Assn.*, 1919, xii, 71) there were 8 deaths, a mortality of 1.4 per cent. In this series there were 374 supravaginal operations, 63 panhysterectomies and 63 vaginal hysterectomies, and the particularly good results that have been attained have been attributed to three points in technic. In the first place, the author believes in the omission of the usual preoperative purging which is so commonly used in the preparation of patients. Such purging causes a dehydration of the patient and adds materially to the production of postoperative shock, and he believes that by merely giving the patient an enema much better results will be obtained. Another point that he has frequently mentioned in the past is the use of the Trendelenburg position, not only during the operation but while the patient is being put under the influence of the anesthetic. By the use of this procedure it has been found that by the time the operator has opened the peritoneal cavity the intestines will have gravitated out of the pelvis of their own accord and will not require the usual amount of handling in being "packed off." By thus eliminating a large amount of manipulation of the intestine, another cause of shock as well as postoperative ileus is removed. Finally, morphin is used freely in the postoperative treatment of these cases, and by thus keeping the patients in comparative comfort the psychic as well as the pain factor in the production of shock is eliminated. The observance of such apparently small points in technic are indeed of great importance and mark the difference between the real surgeon and the ordinary operator. There are many operators who are good technicians so far as the actual operating is concerned, but whose results suffer by comparison with the work of others merely because they have failed to observe these finer points in technic.

Roentgenographic Diagnosis in Renal Tuberculosis.—The roentgenographic data in renal tuberculosis are regarded of such importance at the Mayo Clinic that, according to BRAASCH and OLSON (*Surg., Gynec. and Obst.*, 1919, xxviii, 555), it is a rule to make a complete roentgenographic examination of the urinary tract in every case in which renal tuberculosis is suspected. The frequency with which positive data may be obtained in the roentgenogram is evidenced by the fact that in the years 1916 and 1917, 131 patients were operated upon for renal tuberculosis, and roentgenographic examination of the urinary tract had been made in all. Of this number, positive shadows suggestive of urinary tuberculosis were found in 30 patients, a percentage of 22. It may be stated, therefore, that approximately 1 out of 5 patients with renal tuberculosis will have positive roentgenographic data of definite diagnostic value. Such data are of particular diagnostic value when, because of the contracted condition of the bladder or impassable stricture of the ureter, the cystoscopic findings are

inadequate or when the cystoscopic findings are not typical of renal tuberculosis. Furthermore, they are of special value when the clinical findings are not suggestive of renal tuberculosis or of any involvement of the urinary tract, as may occur with a closed tuberculous pyonephrosis. The roentgenographic shadows are caused by the deposit of calcium in the tuberculous area and may assume a variety of forms. To one who has had considerable experience in roentgenographic interpretation such shadows will have characteristics that are usually recognized and may be differentiated from a stone shadow by (1) the variability in its density, as the shadow is irregularly concentrated in its different portions; (2) by a shadow of lesser density throughout than that usually observed with stone; and (3) by its irregular and indefinite outline. The calcareous area may, however, simulate the shadow of a renal stone in every particular, and it may be quite impossible to differentiate it without further clinical data. The same is true of renal stones that are occasionally seen of such consistency that the shadow will be fully as irregular and hazy in outline as a typical tuberculous shadow. It may be said, however, that approximately 75 per cent. of tuberculous renal shadows may be recognized as such in the roentgenogram.

Prolapse of Uterus in a Young Virgin.—To most practitioners the the subject of uterine prolapse probably calls to mind a middle-aged woman, who has had many children or very difficult labors, with severe lacerations of the pelvic floor. It may be of interest, therefore, to refresh our memory on this subject and recall that occasionally uterine prolapse occurs in a virgin usually after the age of thirty. The case reported by MOORHEAD (*Surgical Clinics of Chicago*, April, 1919, p. 407) is of unusual interest, in that it occurred in a virgin who was only eighteen years old. When she presented herself for treatment she gave the usual history of a swelling at the vulva which had been present for one year, aggravated by exertion, and which disappeared when she was recumbent. There was nothing in her history to indicate the cause of this condition aside from the fact that she had been forced to do very hard and laborious work since she was twelve years old. The prolapse was a complete one, the uterus extending two inches outside of the vaginal outlet, drawing the anterior vaginal wall with it, although the posterior wall was only slightly involved. In the treatment of this case the author performed a high amputation of the cervix, shortened the uterosacral ligaments by plication and shortened the round ligaments by the Gilliam technic. The usual explanation of these cases of prolapse of the uterus in virgins is that there is a congenital weakness of the uterine supporting structures, especially the uterosacral ligaments and the connective-tissue structures in the bases of the broad ligaments, frequently called the cardinal ligaments. Naturally these structures must give way before a prolapse can occur, but whether they are congenitally weak or are weakened by an unusual amount of strain, as the author believes to have been the case with his patient, is a point that will have to remain debatable.

OPHTHALMOLOGY

UNDER THE CHARGE OF
EDWARD JACKSON, A.M., M.D.,

DENVER, COLORADO,

AND

T. B. SCHNEIDEMAN, A.M., M.D.,
PHILADELPHIA.

Etiology and Prophylaxis of Scrofulous Affections of the Eye.—STEINER (*Ann. d'ocul.*, April, 1919, p. 228), who has practised for many years in the island of Java, writes that the rarity of scrofulous affections of the eye and of scrofula in general is very striking in that country. He believes the cause of such immunity to be due to the fact that the people of the island, dwelling as they do, in a tropical climate of continuous warmth, are much more scantily attired than the inhabitants of Europe and their bodies exposed to the sun's rays. The same conclusion is suggested by the good results which have been obtained in Europe in these affections by the so-called "sun cures;" it is also supported by the successful results from other methods of treatment in use for a longer or shorter period of time, which have this in common that they act upon the skin by stimulation (artificial light, salt baths, sea bathing, Kapesser's treatment by friction with black soap). He recommends giving the youth of Europe the benefit of the quasi immunity of the Javanese by greater exposure of the person to the sun's rays and reforming the dress. He recommends for children during the warm season a garment light in weight and light in color, leaving exposed the arms, legs, part of the breast and back, no stockings and sandals in place of shoes. He calls attention to the fact that in Java pulmonary phthisis is extremely severe, while tuberculosis of the bones is rather rare. Treatment by exposure to the sun's rays is very efficacious in the latter, while the former appears to be refractory to it, a circumstance which he thinks tends to support his views.

Diagnostic Value of the Ocular Syndrome of Hypertension in Wounds of the Cranium, Including Trephining.—TERRIEN (*Arch. d'ophthal.*, July-August, 1918, p. 255) studies, following wounds of the cranium, a peculiar ocular syndrome, particularly interesting in that it frequently occurs alone to the exclusion of any other general syndrome, while the vision itself may remain normal. The syndrome is characterized by the following triad of symptoms: attacks of diplopia, narrowing of the visual field and papillary stasis, the latter being much the more common. He finds as the result of observation in 20 cases that the stasis is ordinately very moderate and not generally accompanied by any diminution of the visual acuity; its sole subjective symptom being transitory obscurations of short duration. Cantonnet, in 1915, and Dantrelle, in 1916, have reported quite a number of similar observations. As regards the attacks of diplopia the latter is

homonymous and due to compression of the external oculomotor nerves. The pathogeny seems identical with the double vision of intoxication, transitory intercranial hypertension. The narrowing of the visual field and enlargement of the blind spot are quite marked, but never sufficient to disquiet the patient, who, in fact, has no suspicion of their presence. All these disturbances disappear under lumbar puncture; they deserve to be sought for inasmuch as they may readily pass unperceived, and may lead to the discovery of an unrecognized cerebral lesion.

Diffraction in the Human Eye and the Phenomena of Colored Rings Surrounding Luminous Sources.—SHEARD (*Am. Jour. Ophth.*, March, 1919, p. 185) notes the universality of colored rings and coronæ surrounding luminous sources under fairly favorable conditions of observation. These rings are due to the diffraction of light by the constituent parts of one (or more) of the ocular media. The first, which is commonly the only one seen, is due to diffraction of the cells of the anterior epithelial layer of the cornea or possibly to the endothelium of Descemet's membrane (Druault). The second ring is evidently due to diffraction by particles of a smaller size than those which produce the first ring. The writer suggests the inner layers of the anterior epithelial portion of the cornea. This ring has been attributed by Druault to the lens fibers, but such a view is not tenable. The ciliary corona is due to the lens fibers and the striæ to the lens star.

Treatment of Keratoconus.—EPPERSON (*Ann. d'ocul.*, April, 1919, p. 226) discusses correction of keratoconus by Müller's shells. The ophthalmometric measurements show that the refraction of these shells when applied to the cornea by the interposition of gelatin or some similar substance is several diopters less than of the same measurements upon the bare cornea, due to the fact that the posterior surface of the shells is more strongly curved than the anterior, so that the shell acts like a divergent meniscus. He has constructed an artificial eye with Müller's shells taking the place of the cornea and thus has been able to measure directly by skiascopy their total refractive power. In this way he has been able to show that the shells are frequently astigmatic, particularly oblique and also a conical deformity which affects at least a quarter of the surface. Müller's shells are better tolerated than Sulzer's contact glasses, and much more serviceable from the optical standpoint, although it is very desirable that the shells be improved from the latter point of view. It is possible to correct by means of the shells not only keratoconus and irregular astigmatism but also high myopia (by weakly refracting shells) and aphakia (by shells of strong curvature).

Tuberculin in the Diagnosis and Treatment of Eye Diseases.—TÖRÖK (*Arch. Ophth.*, May, 1919, p. 242) in a discussion of this subject comes to the following conclusions: For diagnosis and therapeutic purposes in eye conditions only the subcutaneous injection of fresh solutions of tuberculin is of value; it can be used in children as well as in adults, with practically no danger. An eye condition is to be considered tubercular only when a positive focal reaction has been

observed. When such cannot be obtained but a positive general and local reaction is present, and every other possible cause for the eye condition is with reasonable certainty excluded, the case may be considered to be of probably tuberculous origin. The treatment should begin with a very small dose, $\frac{1}{10000}$ mgm. and increased to the maximum of toleration; it should never exceed 1 mgm. The duration of treatment must be long continued, even for several years. Tuberculin is of least value in chronic uveitis cases, with the exception of heterochromic cyclitis; it is most satisfactory in scleritis and periphlebitis retinæ. Scleritis, deep and interstitial keratitis and iridocyclitis are closely related to each other and may change from one condition to the other. Exudative choroiditis is seldom of tubercular origin; the teeth are often the source of infection in these cases.

Syphilis and Irregularity of the Pupil.—DUJARDIN and RASQUIN (*Ann. d'ocul.*, February, 1919, p. 89) by the term irregularity of the pupil qualify any angulation of the circumference of the same. Normally the pupil is quite circular or at most slightly oval, with the long axis sensibly vertical. The pupil should be examined for irregularity both by natural and artificial light. As a result of their studies they find that irregularity of the pupil is an extremely frequent symptom in the course of syphilis, especially from the secondary stage onward, and the more frequent with the lapse of time; in fact, such irregularity may be the sole pupillary symptom in advanced syphilis. Irregularity of the pupil is probably syphilitic in 70 per cent. of all such instances, so that every case of "essential" irregularity should be examined serologically and even by lumbar puncture.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

OSKAR KLOTZ, M.D., C.M.,

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

The Clinical Value of Complement Fixation in Pulmonary Tuberculosis Based on a Study of 540 Cases.—One of the most difficult problems for the clinician after a diagnosis of tuberculosis has been made is the determination of the presence or absence of activity. The definition of "activity" will always arouse debate and in this case the authors adopted hard and fast rules for the determination of active tuberculosis. The subcutaneous tuberculin test was used for a time as a most reliable diagnostic test for early clinical tuberculosis, but it has since been found not applicable in febrile and hemorrhagic cases, diabetes, nephritis, cardiac involvements and in pregnant women. The complement-fixation test is now being used in many sanatoriums and offers valuable aid to the clinician. BROWN and PETROFF (*Am. Rev. Tuberc.*, 1918, ii, 525) record their experience with the test made

on 540 cases which may be divided into three usual groups: incipient, moderately advanced and far advanced. They used a glycerin antigen of the tubercle bacillus which gave the best results though not a 100 per cent. positive reaction. No antigen yet discovered produces perfect results. The authors found that a positive complement fixation indicates that antibody is or has recently been circulating in the blood stream. The far-advanced cases react positively more frequently to the test than the moderately advanced and the moderately advanced than the incipient. Only one combination of clinical data will predict fairly close (95 per cent.) the presence of a positive complement-fixation test. This test is more likely to be positive when tubercle bacilli have been found in the sputum and when hemoptysis without tubercle bacilli has occurred. About 10 per cent. of the patients having tubercle in the sputum react negatively to the test. The intradermic tuberculin reaction and the subcutaneous tuberculin test do not run parallel with the complement-fixation test. The former are in most cases more persistent but occasionally patients will react positively to the complement-fixation test and negatively to the subcutaneous tuberculin test. Various factors will interfere with the test; for example, patients with pleurisy with effusion do not react readily to the complement-fixation test. The authors feel that this test is of value to the clinician and like the subcutaneous tuberculin reaction is of more value when it is negative than when positive in the determination of which patients used treatment.

Attempts to Reduce the Resistance of the Guinea-pig to Tuberculosis by Means of Various Agents.—It is often convenient in making a rapid diagnosis of tuberculosis by means of inoculation of the infected material into guinea-pigs to reduce the resistance of the animal and thus shorten the time of incubation from the usual five to seven weeks to eight or ten days. According to Morton, one massive dose of roentgen rays administered just before or after inoculation will lower the resistance sufficiently. But not every laboratory is equipped with a roentgen-ray machine so CORPER (*Am. Rev. Tuberc.*, 1918, ii, 587) undertook a series of experiments, with a view to finding a substitute for the roentgen ray. He tested guinea-pigs with injections of various materials, a mixture of benzene and paraffin, thorium X, tuberculin and ether by inhalation. It was found that neither a single large subcutaneous injection of benzene nor repeated small injections have any influence upon the course of macroscopic tuberculosis in the guinea-pig infected with human tubercle bacilli. Since benzene lends itself well for inhalation experiments and believing that a more profound effect of the benzene could be obtained a series of experiments was undertaken. They indicated that benzene administered to guinea-pigs by inhalation to the point of unconsciousness daily during a period of about a month, beginning inhalations at the time of infection or twelve days prior has no influence upon the course of tuberculosis as measured by the macroscopic anatomic involvement. Having failed to reduce the resistance of the guinea-pig to tuberculosis by means of benzene it was deemed advisable to repeat the investigations with the roentgen rays in animals given definite amounts of human tubercle bacilli and suitably controlled. The author's

experiments show that a single large exposure to the roentgen rays (Morton's method) or a single large one followed by a series of smaller exposures has no influence upon the progress of the macroscopic anatomic tuberculosis in the guinea-pig even though this produces a temporary leukopenia as low as 2000 leukocytes per cubic millimeter. Experiments with thorium X given in amounts sufficient to maintain a marked leukopenia throughout the period of infection and tuberculin in large doses had no appreciable effect upon the course of human tuberculosis in the guinea-pig. Nor did ether by inhalation to the point of light anesthesia for a long period of time increase the susceptibility of the animals.

Hypertrophy of the Adrenal and Retention of Adrenalin in Infections, Intoxications and Certain Immune States.—Hypertrophy of the adrenals in intoxication is classic even since the works of Caussade and ever since the discovery of adrenalin the medulla of the adrenal has been studied to determine the effect of an increase or diminution in the amount of adrenalin in producing certain pathological states. The arterial hypotension in toxic infections or in intoxications has been attributed to a diminution in the secretion of the medulla of the adrenal. In fact, adrenalin, after the teaching of physiologists, ought to maintain the activity of the sympathetic system and the cardiovascular tonicity. This conception, which was classic and has been applied most often, has been denied by Gley and his collaborator, Quinquand. PORAK (*Jour. de phys. et de path. gén.*, 1919, xviii, 95) performed a series of experiments to study the arterial pressure and retention of adrenalin by the adrenals in different infections and intoxications. The author noted also the variations in the weight of the adrenals at different stages of the infections and intoxications and compared the weight with that of the body. Of the normal animals studied the author used monkeys, rabbits, guinea-pigs, rats and man. Of infections he used rabies in a rabbit, tetanus in a guinea-pig and rabbit, poliomyelitis in a monkey, diphtheria in a guinea-pig and a rabbit, pneumococcus in a rat and various other infections in man and animals. Experimental tuberculosis, purulent pleurisy in a rabbit and three infant cadavers, one a case of tuberculosis and two of bronchopneumonia. Of intoxications, he studied typhoid fever in a man, intoxications in guinea-pigs by mercury, lead, strychnin, chloroform and various types of endogenous poisons. The author is able to report that the relation of the weight of the adrenals to the weight of the body and the retention of adrenalin by the adrenals do not confirm the importance of the insufficiency of the medulla of the adrenal in infectious diseases. Anatomic pathology teaches that the adrenals can be the seat of hemorrhages or of bacterial infections and chronic lesions (scleroses and caseous degeneration). In these cases there exists perhaps a certain degree of glandular insufficiency, but the author completely ignores the mechanism of this insufficiency. The author's purpose was to prove that the adrenals do not interfere by their angiotonic function in infection and intoxications, for there is no relation between the retention of adrenalin by the adrenals and the level of the arterial pressure. Although adrenalin has ceased to play a part as a vascular hormone in infections and intoxications, it is not necessary to attribute it to the

uselessness of the adrenals. It has been found that as the weight of the body decreases in disease processes the weight of the adrenals increases. An increase of weight without congestion of the organ is very significant. The increased weight is not due to an accumulation of adrenalin; it can proceed, for example, from an increase in the retention of water or an abundance of cellular elements. The author does not think these modifications ought to be considered in the majority of cases, as the lesions produce a state of functional insufficiency. He believes that the organ reaches a state of more or less complete rest. The same occurs in pathological processes of most varied character, as the experiments in immunization against tetany and the incubation of rabies proved. When determining the diminution in the amount of adrenalin in the whole organ it is found most often in the hypertrophied portion, not in the medulla but in the cortex. In a further paper the author expects to review in detail the importance of the cortex of the gland.

The Quantity of Circulating Blood Measured by the Number of Red Blood Cells.—There are only two methods commonly employed in measuring the quantity of circulating blood, that of Valentin (1838), since modified many times, and the classic method called the "de Welcker method." It is this latter that BRODIN, RICHET and SAINT GIRONS (*Jour. de phys. et de path. gén.*, 1919, xviii, 8) used in their experiments. The method consisted in anesthetizing the animals (dogs) and drawing blood in varying quantities from the carotid artery, jugular vein or less often the femoral vessels. The circulating system is then flushed with water and the total quantity of blood estimated by the number of red blood cells. There have always been several faults in this method, chiefly that by perfusion one cannot prevent the formation of small plugs in the arterioles and venules, so that the washing of the body does not give the total amount of blood contained in the body. Moreover, the use of water alters the cells so that they give off their hemoglobin which is diffused through the tissue. The authors modified this method in an effort to correct these faults. They used various solutions: sodium citrate, to prevent coagulation and a fluid which will not alter the red cells, so that there will be no diffusion of hemoglobin in the tissues and no coagulation in the smaller vessels. Their results show that the quantity of blood is very unstable, varying from 10 to 20 per cent. in several minutes. The mass of blood per kilogram is with dogs, in spite of great individual differences, in inverse proportion to the weight of the body. Since the body heat is maintained by the blood, and since radiation is dependent upon the surface rather than the weight of the animal, it was found that this mass of blood is proportional to the surface of the body and not to the weight. Further, that for a given unit of weight the surface of the body, the number of red blood cells and the quantity of blood are parallel. In general the greater the mass of blood per kilogram the higher the total number of red blood cells. When the blood mass is greater than 75 grams the number of red blood cells is 5,360,000, for a mass 71 to 75 grams 4,790,000, and for less than 60 grams 4,050,000. As a corollary of this law it was found that the mass does not vary with the percentage of cells and consequently not with the density of blood. For leukocytes,

on the contrary, the greater the percentage the less the mass of blood. Lastly, the smallest amounts of blood compatible with the temporary survival of the animal are in the neighborhood of 25 per cent. of the initial mass, whereas the cells can drop to 5 per cent. of their original number. If the function of the cells is the carrying of oxygen the function of the mass is the giving off of CO_2 and assisting in the organic combustion of cells. Perhaps this diminution in the mass is associated with "acidosis" which has been observed after great traumatic hemorrhages, be it as cause or effect.

The Spirochete of Infectious Jaundice in House Rats in Chicago.—Since the discovery of the spirocheta icterohemorrhagica as the causative agent of infectious jaundice, different workers have found spirochetes answering its description in various numbers of rats and field mice in different parts of the world. Ido observed two cases of Weil's disease following rat bites. OTTERMAN (*Jour. Infect. Dis.*, 1919, xxiv, 485) examined various organs of 30 rats caught in Chicago and found spirochetes resembling the *Spirocheta icterohemorrhagica* in only 2. In one of these the spirochete was found in the mouth and in the other in the kidney. Emulsions of the kidneys of the rats caused the disease in no instance.

A Further Report upon Diphtheroid Infection of Wounds.—Adami, Bowman, Janes and others working in hospitals in England 1917-1918 investigated the occurrences of *B. diphtheriae* and diphtheroid organisms in open wounds. Their examinations of 306 wounds showed 2 to be infected with diphtheria bacilli and 56 with diphtheroid organisms. This investigation was stimulated by that of Fitzgerald and Robertson, who, in September, 1917, had reported the presence of diphtheria bacilli in 40 out of 67 wounds examined. These examinations were made on soldiers returned to Canada from England. JAMES and THOMAS (*Canadian Med. Jour.*, 1919, ix, 434) in a further examination of wounds in England showed diphtheroid bacilli in about 63.5 per cent. of 129 cases. Testing 30 of these diphtheroid organisms culturally and in guinea-pigs, 3 proved to be true Klebs-Loeffler bacilli. This latter figure would indicate about 6.4 per cent. of the wounds examined were infected with diphtheria bacilli. They found membranes in a number of wounds infected with diphtheroid bacilli as well as in those infected with diphtheria bacilli. The cultures were made on wounds of three to seven months' duration. Reports received so far of bacteriological examination of wounds in the U. S. Army do not show such a high percentage of true diphtheritic infections. These examinations, however, have been made of fresher wounds.

Effect of Bile on Clotting Time of Blood.—It is known that jaundice tends to cause an increase in the coagulation time of blood, but a satisfactory reason for this has not yet been given. HAESSLER and STEBBIN (*Jour. Exper. Med.*, 1919, xxix, 445) performed a series of experiments to determine whether or not bile or bile salts which are present in the blood in jaundice are in themselves capable of causing the increase in coagulation time. Cats under ether anesthesia were bled from a large artery and the whole blood and plasma tested with

varying concentrations of ox-bile solution. It was found that within certain limits clotting time depends on the percentage of bile present in solution. With amounts of bile greater than 5 per cent. there was a retardation of clotting great enough to be detected by clinical methods. When sodium glycocholate was substituted for bile the results were the same. The authors further studied to determine whether the bile salts prevented the formation of thrombin or merely interfered with the change of fibrinogen to fibrin, these two steps being generally conceded to take place in the process of coagulation. Solutions of fibrin and thrombin were prepared according to the method of Mellanby. They concluded that bile and bile salts do not interfere with the formation of thrombin, since the prolongation of clotting time is just as great when preformed thrombin is added in ample quantity to fibrinogen solution as when thrombin is formed from its precursors in the presence of bile. Hence they assume that it is the conversion of fibrinogen to fibrin that is interfered with rather than the formation of thrombin.

Agglutination of Streptococci.—Many workers have attempted to classify streptococci by means of agglutination, but the results have never been decisive enough to warrant practical application. NAKAYAMA (*Jour. Infect. Dis.*, 1919, xxix, 489) experimented with nine strains, four of which were from cases of scarlet fever the others from various sources. He found relatively high agglutinin production in immune rabbit serum from the homologous streptococci. There was no constancy in the production of agglutinins for heterologous strains. Among these agglutinins were high in some instances, absent in others. Some relation seemed to exist among three of the strains from cases of scarlet fever, as demonstrated by heterologous agglutination tests. The production of minor agglutinins was lessened by treating the streptococci with cinnabar before injecting them into the rabbits for the production of the immune serum. He concludes that even with this treatment the results are not definite enough to separate the streptococci into distinct groups.

A Characteristic Localization of Bacillus Abortus in the Bovine Fetal Membranes.—The localization and multiplication of bacteria within cells not having phagocytic functions have thus far been demonstrated in leprosy, syphilis and in a disease of mice recently described by Tyzzer, who found an active invasion of both liver cells and intestinal epithelium by a bacillus. In cells to which phagocytic powers have been ascribed the specific localization of certain bacteria is well known. Thus, tubercle bacilli can be found in endothelial cells, leprosy bacilli in a variety of cell groups and the organisms of mouse septicemia occur regularly in certain phagocytic cells of the blood. Recently, bacteria have been found attached to the cilia of the respiratory tract in pertussis by Mallory and Hornor in a form of guinea-pig pneumonia. Sporozoa have often been found in epithelial cells, where they multiply and cause destruction of the cell. It is highly probable that bacteria set in a similar fashion. THEOBALD SMITH (*Jour. Exper. Med.*, 1919, xxix, 451), in studying diseased membranes in cases of infectious abortion of cattle, came upon a peculiar and characteristic habitat of *B. abortus* (Bang) in the epithelial covering of the chorion. He

thinks that the value of this finding cannot be fully estimated until a more complete history of the successive localizations of the bacillus has been obtained, but he feels it is safe to assume that this is the earliest stage in which the organism gains by rapid unchecked multiplication a considerable advantage over the host. The local destruction of an epithelial covering by an infectious agent when other miscellaneous infectious agents are absent may or may not be of much importance, for it would depend on the regenerative activity of the epithelium, the tendency to the gathering of injuries transudates and the toxic substances associated with the bacilli. The author found that localizations of *B. abortus* also occur in the walls of the bloodvessels of the chorion. Thus far he has observed only one case of this kind in which the connective-tissue cells of the adventitia of a vessel 0.8 mm. in diameter were completely replaced by clumps of minute bacilli. Since there is usually a slight perivascular infiltration in the diseased placenta this localization may be largely responsible for the circulatory disturbance which lead to the death of the fetus. The case referred to may be but a greatly exaggerated illustration of the action of *B. abortus* in the walls of the bloodvessels where they are too few in number at any one time to be identified.

The Organisms of Secondary Infection, Especially Pneumococci and Streptococci, in Pulmonary Tuberculosis.—COOPER, DONALD and ANTZ (*Jour. Infect. Dis.*, 1919, xxiv, 498) cultured the blood of 216 cases of pulmonary tuberculosis, of which 36 were far advanced, and found hematogenous infection in 7 of the cases. Four of these, however, were staphylococci, and the authors indicate they were probably skin contaminations. Of the others 1 was *Micrococcus tetragenus*, 1 pneumococcus type II and 1 pneumococcus type IV, with a streptococcus. These results were obtained in broth cultures. All blood cultures in solid media were negative. The case with pneumococcus II was febrile and the case with pneumococcus IV associated with the streptococcus was afebrile. Both of these positive cultures were in far-advanced cases. The occurrence of pneumococci and streptococci in the blood, as found by these authors, is rather low in view of the findings of Pettit and those of Brown, Heise and Petroff. Of 8 cases which died only 1 yielded a positive blood culture postmortem, pneumococcus type II. This case was negative when examined one week before death. The case in which *Micrococcus tetragenus* was found was moderately advanced. Thirty per cent. of the sputa of the 216 cases revealed pathogenic pneumococci and streptococci.

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ORIGINAL ARTICLES

FOOD FACTORS IN GASTRO-ENTEROLOGY,¹

By DR. LAFAYETTE B. MENDEL,

PROFESSOR OF PHYSIOLOGICAL CHEMISTRY IN YALE UNIVERSITY, NEW HAVEN, CONN.

IF one were to interpret the present-day scope of gastro-enterology from the contents of the papers which were presented at the last annual meeting of this Association, it would, I suspect, be difficult to find a place therein for a topic such as I am venturing to discuss at this time. It seems to me, however, that a discipline which relates to "the normal and pathological conditions of the digestive organs" cannot fail to find some interest in the role of the food, for the transformation and transport of which these organs exist, or in the phenomena of nutrition, for which the function of digestion is an indispensable preparation.

There are growing manifestations of a more lively interest on the part of the so-called clinical worker in the contributions of the scientific investigators of the laboratory. It is a platitude to remark that no detail of the fundamental physiology and biochemistry of the alimentary processes should be deemed too insignificant to deserve consideration from the gastro-enterologist. The modern researches on the movements of the digestive canal, the secretions which reach it and the chemical changes which proceed within it are finding applications in diagnosis and therapy of gastro-intestinal disorders. Unfortunately, rational dietetics founded upon the newer knowledge of the chemistry of foods and nutrition has not yet received the discriminating study and advocacy on the part of practical clinicians that its importance unquestionably warrants.

¹ Read at the meeting of the American Gastro-enterological Society, Atlantic City, June 9, 1919.

We may frankly admit that dietetics is at present far from being an exact science, so that dietotherapy is anything but an accurate art. Nevertheless, the limitations of our knowledge, based, in part, on empiricism and modified by that factor of uncertainty described as personal idiosyncrasy, need not disparage the recourse to novel therapeutic viewpoints and new procedures which new scientific facts are likely to initiate when they are given a sympathetic hearing.

The current attitude of aloofness from sane and helpful dietetics in medical practice is largely engendered by ignorance and indifference, conditions which the recent progress in this field should help to dispel. The widely divergent methods now in vogue in the treatment of gastric ulcer—methods which range from enforcement of complete physiological inactivity and absence of food in the upper alimentary tract, as the one extreme, to liberal feeding, intended to secure better healing through improved general nutrition, as the other extreme—illustrate the place which a fundamental understanding of food factors should have in rational gastro-enterology. Indeed, there are few, if any, specialized departments of medicine which would fail to benefit by greater attention to the fitness of the body as a whole. The physiological functions are so widely correlated and interdependent that there is oftentimes danger of overlooking the major advantage because of a concentration of attention upon a more obvious minor defect.

FOOD AND DISEASE DURING THE WAR. The exigencies of the World War and the unusual food situations created by it have compelled thousands upon thousands of persons to alter their traditional modes of nutrition or their customary dietary habits. This change has not been instituted without many protests. Even the finest spirit of patriotism could not always repress misgivings regarding the physiological wisdom of the enforced or recommended innovations of diet. All physicians, probably, can substantiate my assertion that the medical profession received many anxious appeals to corroborate the alleged safety of the dietary restrictions which the governments demanded in the interest of the win-the-war policy. Many of the proposals cost the responsible officials of our Food Administration no little anxiety lest the substitutions and economies and the food sacrifices and modifications of diet might in any way alter the well-being of our population. During the war we have learned the possibility of using more than one cereal to advantage; we have succeeded in lowering the consumption of meat without apparent detriment; we have reduced the intake of sugar to the plane where it represented a condiment rather than a food; we have restored the conserved and less expensive vegetables to a worthy place in the day's food—these and other dietary changes have been instituted amid the fears of the devotees of custom in foods.

It must not be assumed, however, that the enforced war-time restrictions have been attended everywhere with equal nutritional success. The effects of the difficulties in the food situation in the Central Empires of Europe upon the health of their peoples have recently been reported by a no less competent observer than Prof. F. Kraus,² of the Charité Hospital in Berlin. Addressing the members of the medical profession, he referred, in the domain of gastro-enterological disorders, to the numerous cases of intestinal dyspepsia provoked by the monotonous, voluminous diet preponderating in difficultly digestible carbohydrates; to the gastric dyspepsias attended with achylia, less often with diarrhea; to the intestinal fermentations; above all to the induced constipation, flatulence and the induced or augmented catarrhal condition of the bowel; and likewise to an increased incidence of ulcer. Furthermore, Kraus alleged that, among numerous persons in all walks of life, the monotony of the crude diet, the lack of gustatory stimuli and suitable food accessories, and possibly of vitamins, have induced a degree of anorexia or food satiety which has ultimately been followed by inanition. Surely the recital of these untoward experiences affords a cogent argument for a better appreciation of the specific role of the individual nutrients not merely in the physiology of digestion, but also in the clinic of gastro-enteric disease.

SOME NEWER VIEWPOINTS. If we turn to the innovations of viewpoint which the newer physiology offers as worthy of the attention of the gastro-enterologist the modern conception of secretion becomes conspicuous. Twenty years ago, when this Association was still in its infancy, the mechanism of the control of the glandular activities, which are so important in relation to alimentation, was believed to reside in the nervous system. Secretion was conceived to be initiated or inhibited, as the case might be, through the medium of nervous impulses. Today a humoral path of stimulation through the intermediation of chemical substances—hormones or succagogues carried in the blood stream—is becoming well recognized. I cannot but believe that if the various chemical stimulants to secretion, particularly as they occur in our diet ingredients, were better known and appreciated the information would find more frequent application, particularly in relation to the promotion of gastric secretion. It is not too much to hope that selected foods and related substances may before long be expected to accomplish for secretion some of the effects which drugs are at present often called upon to bring about.

VITAMINES AND GASTRO-ENTEROLOGY. The word "vitamine," scarcely five years old, has already become an expression to conjure with. The vague and mysterious characteristics with which it is at present endowed will, I feel confident, gradually acquire a more

² Berl. klin. Wchnschr., January 6, 1919, p. 3.

specific significance as the potencies of "the hitherto unidentified food factors indispensable to normal nutrition" are elucidated by further research. Consider the following striking experimental demonstrations: An animal is placed upon a diet consisting of isolated proteins, carbohydrates, fats and inorganic salts—the traditional mixture of nutrients which the physiology of our teachers has led us to expect to be adequate for the body's needs. Nutritive failure and decline will inevitably ensue, attended by a variety of symptoms, perhaps including those seen in beriberi. An exceedingly small dose of brewers' yeast or a chemical fraction prepared therefrom, or a small allowance of a vegetable like the tomato, spinach or carrot, or an addition of milk or of any of a large variety of naturally occurring foods to the dietary, will bring a restitution of health with a speed and completeness that is little short of marvellous. We are face to face in such instances with the nutrition-promoting potency of something which cannot be expressed in terms of the hitherto recognized nutrients. A ration compounded of washed skeletal muscle (beefsteak), carbohydrate, fat and salts leads to analogous nutritive failure; whereas, the substitution of liver or kidney tissue for the meat, in an otherwise unaltered diet, ensures uninterrupted well-being. In terms of the current hypothesis we have become accustomed to say that the yeast, the vegetables, the milk, liver, and kidney contain an essential food factor or *vitamine*.

Again, if in an otherwise adequate dietary the sole source of fat is represented by lard or one of the familiar vegetable oils, nutritive disaster will ensue sooner or later. During the period of pronounced malnutrition serious eye disease may arise as one of the intercurrent symptoms. The introduction of a small amount of milk fat, liver fat (as in cod-liver oil) or the oil of some of the vegetables, as Osborne and I have lately demonstrated, brings about an almost magical restitution of health. Here evidently we are concerned with the presence in certain of the fats or fat-like mixtures of another potent property distinct from the *vitamine* already described. To these illustrations, so striking that they are not easily forgotten by one who has witnessed the surprising remedial transformations induced by seemingly insignificant quantities of certain food products, may be added the presumably distinct antiscorbutic properties of certain natural foods.

The purpose of these fragmentary references to significant features in the recent studies of nutrition is not to emphasize primarily their broader dietary significance. I desire rather to offer the suggestion that dietary deficiencies, such as are exemplified by the lack of suitable *vitamines* in the ration, may affect the gastro-enteric tract quite as probably as other parts of the organism which are represented in the now recognized so-called deficiency diseases. The gastro-intestinal symptoms in pellagra afford a specific illustration.

At the present stage of our knowledge the gastro-enterologist cannot afford to overlook the possible role of the vitamins in the functions of those parts of the organism with which he is most directly concerned.

In a recent interpretation of the nature of appetite Carlson³ wrote:

"Appetite depends not only on the memory process of past experience, with palatable food as positive phases and the memory process of removal of hunger pangs by feeding, but the presence of this memory process in consciousness depends on certain conditions of the alimentary tract. When the stream of afferent impulses from the alimentary tract and possibly other visceral organs becomes altered in quantity or quality from the normal these impulses suppress or render impossible the existence of appetite. Hence it would appear that the existence of appetite is an indication of a proper condition of the alimentary tract to handle the food in the way of motility and secretion, and that this is the chief biological significance of appetite. The production of appetite gastric juice is of secondary importance and of practical significance only in cases of extreme impairment of gastric secretion."

We have frequently observed that one of the conspicuous manifestations of a dietary regimen deficient in certain types of vitamins is a diminished food intake. The feeding of vitamin-containing products almost always results in an improved appetite, if one may judge this by the resulting ingestion of increased amounts of the same ration which was refused on the vitamin-free regimen. Precisely what the decisive relationships here are—whether improved appetite induced by the vitamin leads to better food intake and hence better nutrition or whether nutrition improved by the potent food factor results in better appetite—can scarcely be decided at the present time. At any rate the possible bearing of vitamins on the problem of appetite and alimentary well-being should not be overlooked by those who are interested in the physiology and pathology of the gastro-enteric tract.

PROTEIN FACTORS. In considering the role of albuminous substances in nutrition the gastro-enterologist is confronted with the unlike digestibility of proteins from different sources. Thus the proteins of some of the legumes, notably beans, are admittedly more resistant to the enzymatic digestive changes than is the case with proteins from many other sources of both animal and vegetable origin in the alimentary canal. Why this is true remains to be elucidated. The tendency for native egg-white to be poorly utilized in the digestive tube has been emphasized by the investigations of Bateman⁴ in our laboratory. He has summarized the objections to

³ *New Aspects of the Significance of Appetite and Appetite Gastric Juice in Practical Medicine*, Interstate Med. Jour., 1917, No. 5, vol. xxiv.

⁴ *The Use of Raw Eggs in Practical Dietetics*, AM. JOUR. MED. SC., 1917, cliii, 841.

the use of raw eggs, which is still widely advocated by some physicians, as follows:

"A substance which fails to stimulate a flow of gastric juice and is antipeptic, which hurries from the stomach, calls forth no flow of bile and strongly resists the action of trypsin, which is poorly utilized and may cause diarrhea, has evidently little to recommend it as a foodstuff of preference for the sound person, let alone for the invalid. And when the native protein needs only to be coagulated, at 70° in order to obviate almost all the effects mentioned, there appears still less reason for using it uncooked. Other considerations strongly support this conclusion."

Another illustration of the resistance to digestion on the part of a protein substance, presumably complete in its chemical make-up, is furnished by wheat bran. If further evidence were needed to demonstrate the failure of its protein to be utilized one could cite the latest experiments on man by Holmes.⁵ Even when wheat bran was ground very fine so as to be rendered more pervious to the digestive secretions the "coefficient of digestibility" did not exceed 45 per cent. Indeed, the advocacy and success of wheat bran as a laxative is based in part at least on this resistance to alimentary digestion.

The three instances just cited exemplify the objections to the use, as nutrients, of protein products known to be difficultly digested because of either chemical composition or physical texture. Such foods must often be excluded in dietotherapy when an undigested alimentary residue, susceptible to microbial changes, with the possible attendant symptoms of intestinal disorder, needs to be avoided. On the other hand it must not be assumed that every protein which is digested with great readiness and completeness in the alimentary tract is on this account an ideal component of the ration. Gelatin is conspicuous for the readiness with which it yields to the proteolytic enzymes of the intestinal canal; despite this easy digestibility, however, it is an "incomplete" protein in the sense that it fails to furnish some of the amino-acids that are indispensable for perfect nutrition. This fact has long been known; and while the use of gelatin as a supplementary food can only be commended, its limitations as the sole source of nitrogen deserve to be reiterated at a time when a concerted effort is apparently being made to increase the consumption of the product.

Again, there are instances of proteins or protein mixtures which are not absolutely defective or incomplete in the sense referred to in the discussion of gelatin, yet are comparatively deficient in the yield of certain "building stones" essential for nutrition. Thus the proteins of wheat flour are easily digested and utilized in the usual sense. Compared with many other proteins, however, they are not economical sources of the nitrogenous nutrient units. Osborne and

⁵ Experiments on the Digestibility of Wheat Bran in a Diet without Wheat Flour U. S. Dept. Agric., Bull. 751, 1919.

I⁶ have recently demonstrated that flour used as the sole source of protein is inferior to many other foods in maintaining adult rats, and especially in promoting the growth of the young. But when the proteins of wheat are fed in combination with about one-third of their weight of the proteins furnished by eggs, meat or milk these cereal proteins are so greatly enhanced in value that flour is thus used most advantageously. In fact, by far the greater part of the flour used in this country in every-day life is actually eaten in combination with those food products which successfully supplement the nutritive deficiencies of its proteins. Adequate nutrition means something more than calories and digestible nutrients; the components of the diet must be appropriate in quality as well as quantity and all of the essential units must be represented.

THE INORGANIC ELEMENTS. In a recent text-book it is stated:

"The mere enumeration of a few of the important uses of the inorganic elements brings out strikingly their significance. The multiplicity of their function has likewise rendered the study of these substances difficult, for with one element having a varied function its removal from the diet may be responsible for many secondary reactions which will mask the direct result."⁷

Despite such generalizations it must be admitted that our knowledge of the functions of the inorganic elements in the body is still very fragmentary and indefinite. As Osborne and I have written elsewhere:⁸ "Although there is almost unanimity of opinion regarding the energy needs of the body under different circumstances of age and activity; although the current estimates of the minimum amount of protein required per day seem to be defined within reasonably narrow limits; although the functions of fat and carbohydrate and the possibilities of their interchange are beginning to be understood; there is no adequate experimental basis whatever to permit tenable statements regarding either the indispensability or the minimum requirement of any of the inorganic constituents of the dietary, with the possible exception of calcium and phosphorus. Statistics show enormous divergencies between the mineral intakes of people in different regions; but these appear to be the fortuitous results of widely unlike dietaries, including water (as is the comparative dissimilarity in the fat and carbohydrate content of the diets of peoples living respectively in a tropical or frigid climate—differences enforced by the unlike character of the available food supplies) rather than the expression of unlike metabolic needs. A beginning has hardly been made in this field of investigation."

The need of certain elements for structural purposes in the body

⁶ The Nutritive Value of the Wheat Kernel and its Milling Products, *Jour. Biol. Chem.*, 1919, xxxvii, 557.

⁷ Carter, Howe and Mason: *Nutrition and Clinical Dietetics*, Lea & Febiger, 1917, p. 78.

⁸ The Inorganic Elements in Nutrition, *Jour. Biol. Chem.*, 1918, xxxiv, 131.

is obvious. The possible part which some may play in the obscure role of "maintaining osmotic equilibrium" is less certain, and when the assumed balance of acids and bases is discussed the border-line of accurate knowledge respecting the individual elements is reached. In studying growth under conditions in which the specific inorganic content of the ration could be fairly well controlled, each element being increased or diminished as desired, Osborne and I found that a lack of calcium or phosphorus promptly effects untoward results. The need of the other familiar inorganic elements, however, appeared to be unexpectedly small. This applied particularly to chlorin, and is presumably true of some of the other elements like sodium, potassium and magnesium. As we have pointed out: "That these may to some degree be essential to the adjustments of neutrality regulation is indicated by the failure to grow when both sodium and potassium were practically excluded from the diet, whereas growth was nearly or quite normal when only one of these elements was missing. That these elements take part in the processes regulating the neutrality of the body fluids is to be assumed from what has been learned by experimental work *in vitro* along these lines, and also from the fact that our experiments with diets essentially free from both sodium and potassium have led to nutritive failure." We concluded that in the long run much smaller quantities of those inorganic elements which can be husbanded will be required for well-being than of those which are needed for the maintenance of neutrality, and hence are continuously eliminated, wholly apart from any quantity necessary for the construction of special tissues like bone or for the production of milk.

The gastro-enterologist is peculiarly interested in the role of chlorin in the organism because of the indispensability of this element in the elaboration of the gastric juice. Common salt has frequently been prescribed to supplement diets presumably poor therein, with the avowed object of averting any failure of hydrochloric acid secretion, particularly because anacidity has been reported as a consequence of a salt-free diet. It must now be borne in mind, however, that when the intake of chloride is restricted the output promptly decreases. In starvation it is almost *nil*. Whatever chlorin is secreted into the stomach is subsequently reabsorbed and consequently conserved. The feces in health carry away little if any chloride. Referring to observations on man, Sherman states that even when there was complete deprivation of salt during ten to thirteen days the total loss did not exceed 10 to 15 per cent. of the amount estimated as usually present in the body. Rosemann has demonstrated that a diet deficient in chlorides leads at most to an insignificant reduction of the total chlorin content of the body in animals. Excretion of the element stops under such conditions, but signs of malnutrition are speedily elicited when chlorin is withdrawn from the body by actual removal of the hydrochloric acid of the

gastric juice through a fistula. Until losses are thus artificially enforced the gastric juice tends to maintain essentially its normal content of hydrochloric acid.

The ability of the animals, which Osborne and I observed, to continue in health for a time on a diet low in chlorin might therefore have been anticipated; but, as we have remarked elsewhere, it could not have been expected that they would continue to thrive so long or attain so many times their original weight on such an extremely low chlorin intake. The outcome of these experiments cannot be due to substitution of other anions for chlorin but is attributable to a husbanding of this specific element. From the therapeutic standpoint the demonstration that a growing animal can fully supply from inorganic sources its requirements of the inorganic elements emphasizes anew that it is unnecessary to consider the presence of calcium, phosphorus and iron, for example, in natural foods to the degree that is currently believed.

FOOD AND THE INTESTINAL FLORA. There are times when the bacterial invaders of the alimentary tract give much concern to the gastro-enterologist. It is, of course, true that microorganisms are always harbored in the recesses of the bowel, but the intestinal flora is by no means a constant one. On rare occasions specifically pathogenic bacteria are present. Under ordinary circumstances the types include more familiar putrefactive organisms, on the one hand, or acidophile bacteria, on the other. Herter and his associates were the first to demonstrate clearly the dependence of the types of bacteria developing in the alimentary canal upon the chemical character of the diet. In general it may be said that abundance of carbohydrates tends to favor the preponderance of the acid-forming types, whereas proteins permit the appearance of putrefying bacteria. Thus one may recall Torrey's observations on the effect of various high-calory diets upon the fecal flora of typhoid fever patients. It was shown by him that with some cases if lactose were added in amounts of 250 to 300 grams a day to the other ingredients of the Coleman-Shaffer diet there resulted a transformation of the fecal flora from the ordinary type to one strongly dominated by *B. acidophilus*. As an added illustration of the fundamental way in which the types of bacteria vegetating in the intestine can be controlled by the chemical character of the food ingested I shall quote from the more recent studies by Torrey:⁹

"In feeding experiments with dogs it has been shown that two carbohydrates, lactose or dextrin, when added to a meat and rice diet caused such a marked development of aciduric bacteria of the *B. acidophilus* type that they completely dominated the fecal flora and effected the almost complete suppression of proteolytic types commonly found in the canine intestinal tract, even including *B. coli*.

⁹ The Regulation of the Intestinal Flora of Dogs through Diet, Jour. Med. Research 1919, xxxix, 415.

This purely fermentative flora would, furthermore, persist as long as the diet was continued, there being no tendency to reversion to the so-called normal flora. *B. bifidus* sometimes increases greatly under these dietary conditions, but generally was soon overgrown and suppressed by *B. acidophilus*, and, in fact, very rarely became the dominant type. A diet of bread and milk, which naturally contains both lactose and dextrin, was also followed by the establishment of a fecal flora consisting almost entirely of *B. acidophilus*."

Again, Torrey writes:

"Starchy foods all tended to effect a simplification of the intestinal flora and an elimination of obligate putrefactive bacteria. These foods with a large starch content differed in some degree in their efficiency as transforming agencies. White bread, potatoes and beans all tended to bring about a predominance of *B. acidophilus*, whereas rice proved rather less effective as an antiputrefactive agent."

And of the protein factor Torrey has this to say:

"Various proteins were found to differ radically in their effect upon the intestinal flora, depending upon their source. Of the varieties tested the proteins of mammalian tissues were the only ones which markedly encouraged the growth and activity of the obligate putrefactive bacteria within the intestinal tract. A diet of fish brought to development a flora which was entirely different from that appearing in association with the feeding of beef hearts. Spore-bearing bacteria did not appear in the fecal specimens in more than insignificant numbers. There was a notable absence of the *B. welchii* types which constitute so large a part of the flora in connection with a meat diet. On the other hand, bacteria of the *B. coli* and *B. proteus* types were strongly predominant. Milk casein as an article of diet exhibited far less tendency to give rise to intestinal putrefaction than did meat protein. . . . Vegetable proteins stand in strong contrast to animal proteins, especially meat, in that they do not offer the slightest encouragement to the growth of intestinal putrefactive types of bacteria. In fact, with a bread containing a very high protein content with a minimum of carbohydrate as marked an overgrowth of aciduric intestinal bacteria occurred as was observed in connection with diets to which considerable amounts of lactose or dextrin had been added."

It is needless to multiply quotations. They are concordant in suggesting that diet can probably be made a more potent factor than are ingested bacterial cultures in regulating putrefactive conditions in the bowel. The determination of the conditions under which desired intestinal floras can be established opens a fruitful field for the clinical investigator.

Dietetics offers no cure-alls to the gastro-enterologist, nor does any other mode of therapy. Calories, proteins, vitamins, acidophilic bacteria—these merely furnish viewpoints from which impor-

tant problems of practice may be examined. The student of foods and nutrition is wont to be reminded that "a little knowledge is a dangerous thing." This is doubtless true, but I cannot gain the conviction that utter ignorance is a safety device. My sole justification for presenting a consideration of some food factors in nutrition has been the hope that the fragmentary items hastily reviewed may perchance suggest new possibilities in the practice of gastro-enterologists. Huxley once wisely remarked that science commits suicide when it adopts a creed. The open mind continually receptive to new suggestions guarantees a more healthful life.

OBSERVATIONS IN THE TERMINAL STAGE OF A CASE OF HEPATIC CIRRHOSIS.

BY FREDERICK M. ALLEN, M.D.,

DIABETIC SERVICE, U. S. A. GENERAL HOSPITAL NO. 9, LAKEWOOD, NEW JERSEY.

THE patient in question was a private, aged twenty-nine years, born in Italy, and a barber prior to being drafted into the military service. His father died at fifty-nine of unknown cause. His mother, one brother and three sisters are alive and well. He gave a history of measles in childhood, chancre or chancroid six years ago, for which he received two salvarsan and two mercury injections at the time, and gonorrhea three years ago.

Otherwise he was well until a left inguinal hernia appeared two years ago and one on the right side six months later. He was admitted to the hospital July 28, 1919, for operation, and the examinations on the surgical service showed nothing wrong except the hernias. He deserted August 7, was brought back August 29 and the hernias were repaired by Andrews' method under ether on September 3. Very large scrotal hematoma ensued, and on account of persistent oozing a coagulose injection was given on September 6. The wounds broke down and healed slowly by granulation, with return of the hernias. Large quantities of blood were passed by bowel on the days following operation. Fluid accumulation in abdomen coming on during this time was assumed to be due to hemorrhage. October 21 to 28 the patient went through typical influenza, which was then epidemic in the hospital. On the medical service the abdomen was tapped November 6, removing 7500 c.c. clear fluid, which gave a two-plus Wassermann reaction. Careful physical examination revealed nothing abnormal except a distinctly palpable spleen; the liver was not enlarged. Investigation was interrupted by the escape of the patient on November 8, due to his feeling so well after tapping. He was brought back February 19,

1919, in advanced weakness and emaciation, with slight icterus and large ascites present. He stated that he had been in bed most of the time while absent and that a local physician had tapped his abdomen eleven times and treated him with salvarsan, mercury and potassium iodide. Though negative Wassermann tests were obtained in blood and ascitic fluid, mercury and iodide were vigorously pushed in the hospital. A summary of other laboratory reports on various dates is as follows:

Ascitic fluid clear, pale straw color; no bile; specific gravity, 1010; albumin, 6 gm. per liter. Cell count 32 per field; many lymphocytes, few peritoneal cells. No bacteria in smear. Culture sterile.

Urine: Normal at first. After February 20 traces of albumin; many hyalin and granular casts; positive guaiac, 20 to 30 pus cells and 200 to 300 red corpuscles per field. Bile negative.

Blood: Hemoglobin, 65 per cent. on October 23. Red count 3,470,000 on October 3; 4,340,000 on October 23; 3,960,000 on February 20. Leukocytes, 4500 to 11,000; polymorphonuclears, 67 to 71 per cent.; large mononuclears, 5 per cent.; small mononuclears, 16 to 24 per cent.; transitionals, 3 to 6 per cent.; eosinophiles, 2 per cent. Red cells show achromia, anisocytosis and poikilocytosis, but no polychromatophilia. No normoblasts or megaloblasts. Blood platelets normal in number. Clotting time, two minutes forty-five seconds. Bleeding time, eight minutes, thirty seconds. No digestion of clot after twenty-four hours.

Feces negative for blood and otherwise on October 22.

On March 2, 10 liters of straw-colored fluid was removed from the abdomen without completely emptying it. The patient continued to appear about the same and was eating regularly until he passed unexpectedly into coma on the night of March 7-8.

The above records were all made in other wards. At 10 A.M. on March 8 the patient, in full coma, with marked hyperpnea, was transferred to the diabetic ward. Rectal temperature, 97° F. Pulse, 96. Blood-pressure: 90 systolic and 60 diastolic. Respiration 24, very deep, audible, typical air-hunger character. Lumbar puncture was performed at 10.30 A.M. to relieve possible pressure and also with a view to Wassermann and other tests, but in repeated attempts only a few drops of fluid contaminated with blood were obtained. Other procedures were as follows:

11 A.M. Catheterization. Urine amber, turbid.

11.20. Paracentesis abdominis. Fluid clear, pale straw color. Peritoneum not emptied. Cannula left in place.

11.45. Blood-pressure, 102-75. Injected into peritoneum through cannula 3 liters of solution containing 0.85 per cent. NaCl and 10 per cent. glucose. Cannula still left in place, with clamped tube attached.

A series of blood-pressure readings thereafter were 110 to 115 systolic, 70 to 75 diastolic. There was distinct strengthening and

reviving effect, so that the patient moved and opened his eyes about an hour after the injection; but consciousness was not regained, dyspnea persisted unchanged and the strength again gradually failed.

2.30-3 P.M. Intravenous injection of 500 c.c. 5 per cent. glucose solution.

3.30 P.M. Peritoneum emptied as completely as possible through the cannula, which was then withdrawn. Fluid water-pale.

4.00 P.M. Catheterization. Urine lighter colored than before.

4.30. Blood-pressure, 110-70.

5 P.M. Blood-pressure, 85-60.

As the weakness was at a dangerous point, 500 c.c. 5 per cent. glucose solution in distilled water was again injected intravenously. A reviving effect was perceptible, but very slight and transitory, and the decline continued.

7.15 P.M. Blood-pressure, 65-40.

11.50 P.M. Heart and respiration ceased.

Autopsy was performed by Lieut. J. W. Sherrill. It showed, in summary, some old left-sided pleural adhesions and slight apical tuberculosis of the left lung; a small, hard, hobnailed liver weighing 1125 grams, with thickened capsule and grayish-yellow color, nearly bloodless; an abnormally large and firm spleen weighing 610 gm., with thickened opaque capsule; kidneys and other viscera apparently normal. The slight yellowish tinge of skin and conjunctivæ was held to be not true icterus. The peritoneum still contained 3 liters of clear pale fluid. Careful search was made in the brain, lungs and coronary circulation for embolism or thrombosis and no anatomical cause of acute death was found anywhere. Microscopic sections of the principal viscera showed no important abnormalities except in the spleen and liver. In the spleen nothing was noticed except a less marked increase of connective tissue than was anticipated from the gross appearance. The liver was typical of advanced portal cirrhosis, and neither the gross nor the microscopic picture showed anything of the usual appearances of syphilis. It may be added that the clinical record never warranted a positive diagnosis of syphilis.

CHEMICAL EXAMINATIONS. These were carried out by the staff of the diabetic laboratory. The blood plasma showed no perceptible bile color and bile tests remained negative in the urine. Every specimen of plasma and urine was tested with nitroprusside, with negative results; and particularly to rule out the possible presence of β -hydroxybutyric acid alone, each specimen was run through the Van Slyke method for total acetone, no precipitate being obtained before or after adding bichromate. The figures for ammonia and total nitrogen in the urine have been lost, but it can be stated from memory that the ammonia was at a low normal level, and there was nothing remarkable in the total nitrogen either in

absolute output or any unusual discrepancy between it and the urea. The other chemical data are as follows:

BLOOD RECORD.

Time.	Plasma sugar, per cent.	CO ₂ vol., per cent.	Urea, mg. per 100 c.c.	Chlorides gm. per liter.	Corp., per cent.	Total fat.		Cholesterol.	
						Whole blood, per ct.	Plasma, per ct.	Whole blood, per ct.	Plasma, per ct.
9.00 A.M.	0.175	37.5	40.8	6.29	31.0	3.07	3.63	0.25	0.27
2.30 P.M.	0.600	38.5	...	...	28.9				
3.30 P.M.	1.000	25.8	...	...	29.6				
9.30 P.M.	0.638	23.3	...	...	27.2				

URINE RECORD.

	Volume, c.c.	Sp. gr.	Sugar, per cent.	Nitroprusside.	Urea, per cent.	Chlorides, per cent.
11.00 A.M. By catheter	375	1.029	Neg.	Neg.	1.98	1.22
4.00 P.M. By catheter	125	1.027	2.4	Neg.	0.55	1.196

ASCITIC FLUID.

	Volume, c.c.	Sugar, per cent.	Urea, mgm. per 100 c.c.	Chlorides, per cent.
11.20 A.M.	2325	0.203	21.9	1.382
3.30 P.M.	3960	1.940	19.5	1.354

It is seen that there was hyperglycemia to start with, but yet large quantities of sugar could be utilized. The trivial sugar excretion was partly due to the marked renal impermeability. The glucose dosage seemed to be slightly beneficial and probably prolonged life a little, but this stimulating action was less than is often seen in weakened conditions and there was no indication of any specific effect upon the underlying condition. The experience with this patient confirmed an observation which has been made several times on animals—namely, that if there is no lack of water a blood sugar of 1 per cent. or more is borne at least temporarily with no evident injury.

The lipid analyses by Miss Wishart show normal cholesterol in contrast to the high values sometimes reported in liver disease. The total fat was remarkably high in both whole blood and plasma, though the plasma was not noticeably turbid. Such a masked lipemia has been mentioned occasionally in the literature in diabetes and other conditions, but the cause or meaning is unknown.

These observations were merely incidental. The actual reason for transferring the patient to the diabetic service was to determine whether acidosis or any other chemical cause of death could be found, and if so to direct treatment accordingly. The question is of some

theoretical interest, and the failure may be discussed under two headings as follows:

1. ACIDOSIS. The point which attracted chief notice was the resemblance of the condition to diabetic coma. Except for the absence of acetone odor, and perhaps the yellowish tint of the skin, an experienced observer might have thought that this patient, with his emaciation and air-hunger breathing, was actually in diabetic coma. The most diverse diseases, such as diabetes, nephritis, cancer, etc., frequently end in coma, of which the exact cause is unknown. In diabetes the acetone bodies have been seized upon as the explanation, merely because they represent a prominent phenomenon which is accessible to chemical demonstration. The conception of diabetic coma as a simple intoxication by the acetone group of substances is not actually disproved, but the objections to it are such that very few writers accept it. On the other hand there has been widespread adoption of the idea that the cause of death is an acid poisoning, as in animals treated with acid experimentally. Of numerous opposing considerations may be mentioned (1) the varying levels of blood alkalinity at which patients go into coma; (2) the well-known fact that in the acid-poisoned animals referred to there is frequently no period of unconsciousness, and if present it is usually brief and can never extend over several days like diabetic coma; (3) the ability by alkali dosage to keep the blood alkalinity at a high normal level in diabetics who die in deep coma nevertheless. It must therefore be concluded either that the theory of acid poisoning is disproved or else that a fatal degree of acidosis can exist without being revealed by any of the available tests, so that we are again thrown back upon the unknown. Also the assumption has been made that hyperpnea is solely the result of acidosis, without regard for the simple clinical observation that the hyperpnea of diabetic coma, though usually diminished, is commonly not abolished by artificially raising the blood alkalinity to normal.

It was therefore of interest to observe a patient with coma and marked hyperpnea without acetone or any evidence of true acidosis so far as the investigation extended. With regard to all tests of acid-base equilibrium yet devised, attention should be given to factors which the authors of such tests have nearly always overlooked, such as the strong likelihood that toxic states may change the excitability of the respiratory center. If the activity of this center is augmented by substances or agencies other than acids, the work of Yandell Henderson shows how the distribution of bases between blood and tissues may be radically changed. Also, beyond this, there is the possibility of a specific alteration in this distribution from unknown causes to which the peculiar retention of sodium chloride in some conditions offers an easy analogy. It seemed more probable to assume in this case that the hyperpnea was primary like the coma and that the lowering of plasma bicarbo-

nate was secondary and not a sign of acidosis. Therefore no alkali treatment was used, because unpublished animal experiments have shown it to be harmful or fatal under such circumstances.

2. CAUSE OF DEATH. Chemical causes of death reduce themselves essentially to two, either the presence of harmful substances or the lack of necessary substances. The death in this case was not due to accumulation of acetone, bile or the substances (urea and chlorides) indicative of renal failure. Glucose was given partly as a food and partly as a means of diminishing protein and fat metabolism, and thereby the production of toxic substances that might possibly be formed from them; but there was no real benefit. All chemical investigation of physiology is still so incomplete that poisoning by accumulation of abnormal products cannot be excluded, but the other possibility of lack of vital substances, such as an internal secretion of the liver in this case, is equally open. Since it is necessary to admit an entirely unknown cause for fatal hepatic coma, something similar may perhaps hold for diabetic and other forms of coma. The main purpose in reporting this case was to suggest that the cause of the diabetic intoxication should be treated as a subject of investigation rather than as a matter of speculative assumption.

THE DIAGNOSIS OF LATE SYPHILIS OF THE CENTRAL NERVOUS SYSTEM.¹

BY CHANNING FROTHINGHAM, M.D.,

BOSTON, MASSACHUSETTS.

DESPITE the fact that certain investigators have obtained contradictory reports on different specimens from the same collection of blood serum sent to different laboratories for the Wassermann test for syphilis, and despite the fact that under certain conditions other than syphilis a positive Wassermann test occurs in the blood serum, the use of the Wassermann serum reaction for syphilis is becoming more and more of a routine procedure in the practice of medicine. This fact in itself is the most conclusive proof that the serum reaction for the detection of syphilis is of value. In many hospitals it is now the custom to have the Wassermann reaction done on the blood serum as a routine procedure on all patients admitted. Also, more and more of the cases coming to the out-patient departments of hospitals are examined for syphilis by means of this test. The result is that in a great many instances in which syphilis was not suspected the attention of the physician is drawn to this disease

¹ Presented before the Association of American Physicians, at Atlantic City, June 16, 1919.

by the positive findings in the blood serum, and in other cases with suspicious lesions or symptoms the diagnosis is confirmed.

Just what the significance of a positive Wassermann reaction in the blood serum is in each individual case is not always clear. Craig² perhaps expresses it as well as it can be with our present knowledge by the statement that a positive Wassermann reaction, if persistent, means the presence of living spirochetes somewhere in the body.

If there are living spirochetes somewhere in an individual it is important, especially in cases of some years' duration, to find out, if possible, where they are: for if the central nervous system is involved, and the original infection with syphilis occurred some years before, the type of treatment to be instituted is different from that which would be used in early syphilitic infection or in old cases of syphilis in which the central nervous system is not involved. For, Swift,³ Walker and Haller,⁴ and others have shown that certain cases of syphilis of the central nervous system respond to intra-spinal treatment when other forms of treatment have not been so successful. Also, Swift⁵ emphasizes the importance of beginning treatment of syphilis of the central nervous system early if good results are to be obtained.

The question arises, therefore, in cases of syphilis in which the infection is of some years' duration, and in which the presence of the disease was suspected perhaps only by the finding of a positive blood-serum reaction, whether involvement of the central nervous system can be detected without resort to lumbar puncture. Southard and Solomon⁶ state that a positive serum reaction should be followed by lumbar puncture. This decision is of considerable importance to the patient, for the procedure of lumbar puncture, although not dangerous, often requires a rest in bed for several days.

This study of cases of syphilis of the central nervous system which have been under observation at the Peter Bent Brigham Hospital was undertaken with the idea of throwing some light on this point if possible.

Since the hospital opened in 1913 considerable attention has been focussed on the treatment and diagnosis of syphilis of the central nervous system. Therefore in a great many cases a lumbar puncture has been performed in which there were no definite signs pointing toward syphilis of the central nervous system. In this way a considerable number of cases of involvement of the central nervous system have been detected which might otherwise have been overlooked.

It was felt, therefore, that a study of this series of cases would probably include some in which at least there were no outspoken

² AM. JOUR. MED. SC., 1915, cxlix, 41.

³ Am. Jour. Syph., 1917, i, 524.

⁴ Arch. Int. Med., 1916, xviii, 376.

⁵ AM. JOUR. MED. SC., 1916, clii, 490.

⁶ Neurosyphilis, William Leonard, publisher, 1917.

signs and symptoms of syphilis of the central nervous system, and possibly some in which there were practically none that would be detected by the ordinary routine history-taking and physical examination as practised in a good general hospital. Should such cases be found some decision could be reached in regard to the necessity of lumbar puncture. On the other hand, if none were found it was appreciated that no conclusions were justified against an early diagnostic lumbar puncture until a much larger series of cases had been investigated.

At this hospital the cell count in the spinal fluid and the Wassermann reaction with 1 c.c. or less of the spinal fluid are the two tests upon which reliance is placed to show the activity of the spirochetes in the central nervous system. The group studied included 231 cases. All of these cases had a positive Wassermann reaction in *their spinal fluid* when 1 c.c. of the fluid was used and many with a smaller amount. Most of them had an increased cell count in the spinal fluid, but in a few instances the cell count was normal. The history and the physical examination of the cases were studied as they were taken on admission by the house officers. A definite history of infection with syphilis in the past was looked for. In the history of the present illness symptoms pointing toward involvement of the central nervous system were sought. From the physical examination the condition of the eyes in regard to irregularities, inequalities or fixation of the pupil was noted. Record was also made of the absence or exaggeration of the knee-jerks and the presence of a positive Romberg test. Of course, any marked disturbances in muscle power or means of locomotion were noted. Finally a record was made of the result of the blood-serum Wassermann test.

Although the summary of the results of these observations is not the primary object of this study, it seems worth while to simply record them as a matter of general interest. In grouping these cases the diagnosis decided upon for the hospital records was used. Southard and Solomon⁷ have emphasized the point that it is often difficult to decide just what type of lesion of the central nervous system is present in an individual case. Therefore, it is felt that although there might be some difference of opinion as to the diagnosis in these cases, all would agree that syphilis was responsible for the lesions.

Of the 231 cases, 121 were diagnosed as *tabes dorsalis*. Of these 121 cases a definite history of syphilis was obtained in 47; in 11 cases the history was suggestive of syphilis; in 63 cases there was no history of a past infection of syphilis; 112 of these 121 cases gave symptoms in the history of their present illness, which was very suggestive of *tabes*. The symptoms included, in addition to the usual ones of disturbance of locomotion, lightning pains and urinary

⁷ Loc. cit.

difficulties, those which pointed exclusively to the stomach and which under certain circumstances might have been justly attributed simply to gastric disorders. In 107 of these cases the pupils were either irregular in outline, unequal or failed to react to light. In 90 of the cases the knee-jerks were absent, increased or markedly variable in strength on the two sides. The Romberg test was positive in 62 cases. The Wassermann reaction in the blood serum was positive in 75, negative in 40 and not reported in 6 of the cases.

The distribution of these various signs and symptoms, however, was such that there were only 2 of the 121 cases in which it could be said that there were no physical signs or points in the history which would make one think of syphilis of the central nervous system. Of these 2 cases 1, Hospital No. M. 3105, was considered on entrance as a case of probable pulmonary tuberculosis. After his blood-serum Wassermann was found to be positive, and no tubercle bacilli could be found in the sputum, it was decided to lumbar-puncture him to see if any evidence of involvement of the central nervous system could be found. On going back over the history of this case there is mention of a sharp pain in the back near the shoulder-blade off and on for three years and some pain in the legs off and on which did not radiate. Apparently neither pain was described in such a manner as to make the investigator think of the lightning pains of tabes. The other case, Hospital No. M. 1494, was a case of pyloric stenosis, which eventually came to operation for carcinoma of the stomach. The history and physical examination gave no symptoms suggestive of syphilis, and it was only on account of the positive Wassermann in the blood that it was felt worth while to do a lumbar puncture in order to see if by any chance the stomach symptoms might be due to gastric crisis. It is quite certain that had a lumbar puncture not been done on account of the positive blood-serum reaction in this case the diagnosis of tabes would not have been made at this time, for there was enough in the stomach to account for the gastric symptoms.

Of the 119 cases, however, which showed definite signs or symptoms of tabes on examination 2 had been in the hospital before and are particularly instructive. One case, Hospital No. M. 5856, was in the hospital in November, 1913, for the vomiting of blood and gastric symptoms. The roentgen-ray pictures showed stasis in the stomach. The case was operated upon, but no definite tumor was found at that time; but pyloroplasty was done on the ground that there might be some disturbance of the function of the pylorus, due to old scars which were now difficult to see. The Wassermann reaction at that time was positive for syphilis and was ignored because the reflexes were normal and no evidence of syphilis could be found. When this patient entered the hospital again in December, 1916, because of no relief from the gastric symptoms, there were

definite signs of tabes. Because these gastric symptoms did not suggest syphilis, valuable time was lost in the treatment of this patient, which probably would not have been the case had a lumbar puncture been done as a routine procedure after finding a positive serum reaction.

The other case, Hospital No. M. 8029, entered the hospital in November, 1913, with diabetes, and a positive Wassermann test was found in the blood serum on routine examination. No attention was paid to it, however, because of the absence of any physical signs or anything in the present illness suggestive of syphilis. When the patient entered the hospital again in February, 1918, in order to have treatment for the diabetes, there was definite evidence of tabes in the physical signs.

In this group of 121 tabetics there were, therefore, 2 cases, or 1.66 per cent., in which syphilis of the central nervous system had been overlooked because of failure to heed a positive blood-serum reaction, and in 2 others an involvement of the nervous system would have been overlooked if reliance had been placed just on the signs and symptoms.

Of the 231 cases 9 were diagnosed as syphilis of the cerebrospinal meninges. Of these 4 cases gave a definite history of syphilitic infection. In all 9 the present illness pointed definitely to an involvement of the meninges of some form or another, so that a lumbar puncture in each of these cases was indicated. In 7 of the 9 cases the pupils showed irregularity, were unequal or did not react properly. Five had some abnormality of the knee-jerks and 1 showed a positive Romberg. Eight of these cases gave a positive blood-serum Wassermann reaction and 1 a negative. The physical signs in these 9 cases were so distributed that attention would have been called to the central nervous system in 7 of them. In the 2 that did not have physical signs to arouse suspicion of the meninges the history of the present illness was so definite that they would not have been overlooked.

Forty-five cases in this group of 231 cases of syphilis of the central nervous system were diagnosed as general paresis. Of these only 10 gave a past history of syphilis. In 38 the history of the present illness pointed quite definitely to some involvement of the central nervous system. In 35 the pupils showed either irregularity, inequality or disturbance of reaction. In 30 the knee-jerks were either hyperactive, markedly unequal or absent, and in 15 the Romberg was positive; 37 gave a positive blood-serum reaction, 7 were negative and in 1 case there was no report.

The distribution of these various physical signs in the 45 cases was such that in only 4 were there none of them. Of these 4, 3 showed definite points in the history of the present illness that would direct attention to the central nervous system. This makes 1 case of the 45, or 2.2 per cent., in which involvement of the central nervous

system would not have been suspected from the history or physical examination.

This case, Hospital No. M. 2775, came in for supposed kidney trouble with albumin in the urine and some acute febrile infection. After examination it was thought that the albumin was simply part of the febrile attack. The fever gradually subsided and during convalescence the patient suddenly became quite irrational and excited. These attacks continued and the patient was transferred to the psychopathic hospital after a lumbar puncture had shown there was definite syphilitic involvement of the central nervous system. This patient's physical examination and history had not in any way directed either the house officers' or the visiting staff's attention to syphilis up to the time of the mental upset.

One of the cases in which the diagnosis was clear upon entrance to the hospital is of interest in regard to the possibility of an earlier diagnosis had a lumbar puncture been done before treatment had started. This case, Hospital No. M. 5541, had been treated in one of the outdoor departments of a hospital of this city for ten months as a result of finding congenital syphilis in one of her children and a positive Wassermann in her blood. Nine weeks before entrance she had been treated by her family physician for severe headaches, with a change in her glasses, and it was only after this persisted and she told her doctor about the positive Wassermann test in the blood that he sent her to the hospital for lumbar puncture. In this case physical signs were either absent or had been overlooked both at the hospital and by her own physician.

Another case might have been overlooked but for the custom of doing a puncture on suspicious cases. This man, Hospital No. M. 2362, gave a history of an attack of unconsciousness from which he had recovered on entering the hospital. It was found there were some arteriosclerosis and increased blood-pressure, and as the physical examination at that time was essentially negative, it was assumed that the attack had been due to a temporary disturbance in circulation in the brain. It was only when the blood Wassermann was reported positive that a lumbar puncture was suggested.

Fifty-six of the 231 cases were diagnosed as cerebrospinal syphilis. Of these, 28 gave a definite history of infection of syphilis in the past; 51 presented symptoms in the history of the present illness which were suggestive of involvement of the central nervous system; 35 showed inequality, irregularity or some disturbance in reaction of the pupils; in 28 there was some disturbance in the knee-jerks and in 10 the Romberg was positive; 38 of the cases showed a positive serum reaction in the blood, 15 a negative and in 5 the report was missing.

These various abnormalities on physical examination were spread over 48 of the 56 cases, so that in only 8 cases the attention would not have been called to the central nervous system as a result

of the physical examination alone. Of these 8 cases 3 gave definite histories which pointed toward involvement of the central nervous system. In 2 of the remaining 5 cases lumbar puncture was done on very slight evidence. In 1 case, Hospital No. M. 2465, the physical examination and blood Wassermann were negative, and the lumbar puncture was recommended by careful house officers in the outpatient department to see if syphilis might be the cause of the headaches. The other case, Hospital No. M. 6684, had some slight disturbance of memory and a positive serum reaction in the blood.

This leaves 3 cases in this group, or 5.2 per cent., in which syphilis of the central nervous system would have been overlooked except for routine lumbar puncture. In one, Hospital No. M. 6337, there was nothing in the history or physical examination to suggest syphilis of the central nervous system. As the patient had a gumma of the leg she was sent into the hospital for a lumbar puncture as a matter of routine by the house officer to clear up the question of involvement of the central nervous system. It was found that involvement existed.

Another case, Hospital No. M. 6686, had apparently suffered from some disturbance for fourteen years and had been to a good many hospitals. The summary of the physical findings and history made by the house officer at this hospital says that the case sounds like either primary anemia, neurosis or tertiary syphilis. There was nothing in the physical examination or history to make a definite diagnosis, and lumbar puncture was done to clear up the case because all else had failed, and the blood serum was found positive.

The third case, Hospital No. M. 1984, an active business man, came under observation because of a request by an orthopedic surgeon for a general medical overhauling in order to see if a cause could be found for an arthritis in the hip. A history of syphilis, some twelve years before, was given, and although it was felt that the hip arthritis was not due to syphilis a Wassermann reaction was taken in order to see if the treatment for the syphilis in the past had been successful. The Wassermann reaction was found positive, and simply in order to clear up the possibility of involvement of the central nervous system a lumbar puncture was done. The cell count in the spinal fluid was increased and a positive Wassermann reaction was found. This patient showed no signs or symptoms suggestive of involvement of the central nervous system.

From this brief summary of the cases of syphilis of the central nervous system that have been observed at the Peter Bent Brigham Hospital it is apparent that in a very high percentage of the cases there are strongly suggestive symptoms in the history or positive signs on the physical examination. It must be borne in mind, however, that many of these cases might have shown an increased cell count and a positive Wassermann test in their spinal fluid long before

any symptoms on the part of the central nervous system appeared. These cases, therefore, help us little, if any, in trying to decide if involvement of the central nervous system in old syphilis occurs without physical or other signs. On the other hand, in all the groups of cases except that of syphilitic meningitis there was a small percentage of cases in which there were no signs or symptoms to call one's attention to the central nervous system. These cases, therefore would have been missed in the routine examination of patients at this hospital but for a custom of investigating the central nervous system in many of the old cases of syphilis discovered on examination or by a routine blood-Wassermann test. Even more striking in regard to the need of investigating the spinal fluid in cases with positive Wassermann, in which the infection was some years previous, are the two cases in which a positive Wassermann in the blood had been ignored because of lack of symptoms or signs and in which subsequently evidence of advanced tabes was found.

This small group of cases shows definitely that it is possible to overlook involvement of the central nervous system with syphilis in an ordinary careful history-taking and physical examination as completed in the wards of a general hospital even when syphilis is known to exist. This possibility of error must become magnified in busy out-patient clinics. The study of the spinal fluid will readily give evidence of syphilis of the central nervous system when symptoms and physical signs are not obtained on careful routine examination.

Therefore, as the procedure of lumbar puncture, although somewhat time-consuming to the patient, is practically without danger; and as it opens up a means of diagnosing late syphilis of the central nervous system when other diagnostic means fail, and as late syphilis of the central nervous system calls for special form of treatment, it seems fair to demand that in all cases of old syphilis a lumbar puncture should be performed as a diagnostic procedure before instituting treatment.

THE MURMURS OF MITRAL STENOSIS AND OF AORTIC REGURGITATION.

BY HAROLD E. B. PARDEE, M.D.,

ASSISTANT ATTENDING PHYSICIAN, NEW YORK HOSPITAL; CONSULTING CARDIOLOGIST,
MOUNTAINSIDE HOSPITAL, MONTCLAIR, N. J.; FORMERLY CAPTAIN,
MEDICAL CORPS, U. S. A.

OWING to the difficulty of hearing the very earliest murmurs of aortic regurgitation and of mitral stenosis, this work was begun in the hope of finding some specially advantageous method of examination which would make these murmurs more readily audible or

more characteristic. Especially advantageous methods have been found, and, moreover, most interesting facts have been observed in regard to the minimal murmur which may be considered as due to a mitral narrowing.

Thirty-six patients with valvular disease were studied for this purpose, the work being done at the Military Heart Hospital at Colchester, England, where they had been sent for diagnosis and for discharge from the British Army. They were all up and about and performing moderate physical exercise, in spite of which none complained of any symptoms of failing circulation to indicate that they should be relieved from the exercise routine of the hospital. They were all cases without signs of cardiac insufficiency, not necessarily cases which had recently acquired the valvular disease or in whom the lesion was not well advanced, but having a heart so little diseased as a whole that it was able to carry on its function in a practically normal manner even when the patient engaged in the activity afforded by the exercise classes. There were many cases of combined aortic and mitral disease in the series, 19 having aortic regurgitation and 2 of these aortic stenosis also, while 22 cases were considered to have mitral stenosis. There were 10 other cases which showed atypical murmurs of mitral stenosis and which lacked sufficient other evidence to make the diagnosis certain.

The cases were examined under eight different conditions, to determine which if any were the most favorable for bringing out the characteristic murmurs: (1) standing upright; (2) standing upright with the chest held in forced expiration; (3) standing with the trunk bent forward at an angle of 45 degrees to the horizontal; (4) lying on the back; (5) lying on the back with the chest held in forced expiration; (6) lying on the left shoulder and side, the trunk turned so as to be about 45 degrees from the horizontal; (7) after exercise, hopping on both feet, rising three or four inches from the floor about thirty times in succession, the patient was listened to standing upright; (8) lying on the left side as in (6). Each case was auscultated both with the stethoscope and with the direct ear against the patient's chest.

MITRAL STENOSIS. It is of course necessary to define the murmurs which have been considered diagnostic of each of the valve lesions in order that we may consider their variations. For mitral stenosis there has been demanded a prolonged, low-pitched, rumbling sound at the apex of the heart, occupying most of the period between the second heart sound and the first. It need not occupy all of this diastolic period, but it is insisted that it is a prolonged and not a short sound and that it is of a rough rumbling character, not humming. In almost all cases there is a rougher short accentuation of this rumble, occurring just before the first heart sound and having a crescendo character. The crescendo portion of the murmur may or may not be continuous with the longer rumbling portion which

precedes it, but is always continuous with the first sound. It is not, as has been implied, found in all cases, being absent in two of the cases of this series and also in all cases of auricular fibrillation with a heart-rate below 68 per minute. No cases of auricular fibrillation are included in this series because of the great influence of heart-rate upon the quality of the murmur. It must be emphasized that these murmurs of mitral stenosis, especially the crescendo murmur, are often very narrowly localized at a point at or very near to the actual apex thrust and cannot be heard even 1 or 2 cm. from this localized area.

There are certain other signs of this valve lesion to which we turn for confirmation of our suspicions when the murmur is atypical. We consider these four of importance in the order named: (1) Evidence of mitral regurgitation, *i. e.*, a distinct blowing or harsh systolic murmur, present when the heart shows no signs of failure, heard at the apex and transmitted to the left and to the right of this point. It must be heard under all conditions of examination and must be associated with enlargement of the heart to the left to beyond the midclavicular line. The presence of mitral regurgitation indicates disease of the mitral valve, and since disease has attacked this valve there is an increased likelihood of a stenosis being present also; (2) a sharp slapping apex impulse; (3) a sharp snapping first sound at the apex; (4) evidence of rheumatic disease of the aortic valve. This increases the likelihood of there being other foci of disease in the heart, and it is quite common for both of the valves to be affected. A word of caution is necessary in regard to the sharp first sound and the slapping apex impulse, for it must be remembered that these are accessory signs and not diagnostic signs. A diagnosis should not rest on them alone no matter how pronounced they may be.

The presence of a diastolic or presystolic thrill at the apex has been omitted as an accessory sign of this lesion, because it is so very difficult and deceptive to recognize, and because, though plain enough in most typical cases of mitral stenosis, it is believed that the thrill is never found to be plainly felt in cases with such slight murmurs that the diagnosis is questionable. It is always better in the interest of the patient to make a negative diagnosis than to bolster up a questionable murmur with a questionable thrill and condemn him to unnecessary restrictions. Patients with the effort syndrome (irritable heart) commonly show a sharp apex impulse and sharp first sound with a simulated presystolic thrill. Such a combination of signs should, of course, make us very suspicious of the presence of mitral stenosis, but a diagnosis without the hearing of a characteristic murmur is certainly quite unjustified.

The presence of an accentuated second sound at the pulmonary area has been omitted as an accessory sign for a quite analogous reason. Undoubtedly it is present in many cases of mitral stenosis,

but it also occurs in very many individuals who have no evidence whatsoever of cardiac disease, in whom, in fact, no other abnormality can be found. Three per cent. of 17,200 recruits examined at Camp Grant, Ill., showed this accentuation. It is considered therefore to be a quite unreliable prop for a doubtful diagnosis.

Enlargement of the heart to the right of the sternum has been omitted as an accessory sign of this lesion because of the fact that this finding is not believed to indicate hypertrophy of the right ventricle, as it has been so often stated to do. The right border of dulness is not due to the right ventricle but to the right auricle. This may be displaced to the right if the heart mass enlarges or may be acutely or chronically enlarged itself. Only the last of these is especially liable to be due to mitral stenosis, and then only when the stenosis is of such a grade as to be readily recognizable otherwise.

Considering our 22 cases of mitral stenosis:

- 2 had only mitral stenosis.
- 6 had mitral stenosis and regurgitation.
- 10 had mitral stenosis and regurgitation with aortic regurgitation.
- 3 had mitral stenosis with aortic regurgitation.
- 1 had mitral stenosis with probable aortic regurgitation.

Comparing the murmur heard in the normal erect position with that heard under the other conditions of examination, in regard to whether the other conditions rendered it more or less loud or typical, the results may be tabulated as follows:

	More.	Same.	Less.
When erect with forced expiration	7	6	8
When standing with trunk bent forward	13	8	1
In dorsal prone position	10	4	8
In dorsal prone position with forced expiration	7	6	7
When lying turned on left side	18	0	4
After exercise, when erect	21	0	1
After exercise, when turned on left side	21	0	1

It is plain that the erect position and the dorsal prone position are of about equal value, though the murmur is louder in one position than in another in about four-fifth of the cases. Furthermore, the erect and dorsal positions in forced expiration are of no different value from the normal erect position. In the great majority of cases the left lateral position makes the murmur more typical or louder, as does the bent forward position to a somewhat lesser extent. In every case but one the murmur is better heard after exercise than before, and in every case but one the optimum condition was the left lateral prone position after exercise.

This one case is quite exceptional throughout in regard to the effect of exercise on the audibility of the murmur, though it was an undoubted instance of mitral stenosis. It was the only one in the series in which the bent forward position and both positions after

exercise were less favorable than the normal erect position, and was one of the four cases in which the left lateral position was less favorable than the erect. The best position for this case was the dorsal position with forced expiration.

The facts in regard to the crescendo murmur are expressed by the following table:

Patient.	Murmur heard.
In erect position	In 4 cases.
In one or more of other positions	{ In 9 cases plainly. In 7 cases poorly defined.
After exercise, lying on left side	In 13 cases.
After exercise, erect	In 7 cases.
Before exercise, lying on left side	In 4 cases.
In dorsal prone position	In 4 cases.
In dorsal prone position with forced expiration	In 1 case.

There were two cases in which the crescendo was not heard in any position.

It must be remembered that after exercise the crescendo is often only present for the first few beats, so that if there is doubt about an observation the exercise should be repeated or perhaps increased in severity and the patient should lie upon the left side promptly.

The main diastolic sound which was heard under the conditions which elicited the crescendo was, with two exceptions, recorded as a "long rumble." In one exception it was recorded as a "murmur" and in the other, a case in which the crescendo was poorly defined, it was recorded as "a long low hum." Both of the two cases which did not develop a crescendo murmur in any position showed a prolonged loud rumble in the favorable positions, and in the erect positions showed a "rumble" and a "hum" respectively.

Eighteen cases did not show a crescendo murmur in the normal erect position. Two of these did not develop one in any position. In 12 of the remainder, when erect, the diastole showed either a long, low-pitched, more or less rough rumble or a low-pitched hum. Two showed nothing at all in the erect position to suggest mitral stenosis, and the only abnormality shown by the other two was a prolongation of the first sound in one and a short diastolic sound recorded as a third heart sound in the other. Nevertheless, in all of these cases a more or less well-defined crescendo, together with a diastolic rumble was produced in at least one of the other positions. The value of using the other positions is quite evident.

From these observations on the variations of the murmur it appears as if the mitral narrowing which in typical cases produces the long diastolic rumble with or without the crescendo accentuation before the first heart sound, produces under other circumstances either no abnormal sound, a prolongation of the first heart sound, a short diastolic sound of the quality of the third heart sound or a

more or less faint, low-pitched, humming, diastolic sound. Individual cases will often show a sort of progression in this series as we listen with the patient in increasingly favorable positions. For example, Case 41 showed a "loud diastolic hum" in the normal position which was "louder" in forced expiration; in the bent forward position it was recorded as "a long low-pitched rumble;" in the dorsal position as "a short low-pitched murmur starting at the time of the third heart sound;" with forced expiration it was "unchanged;" in the left lateral position it was "a long low-pitched rumble;" after exercise when erect "rumble is louder;" when on the left side after exercise a "plain diastolic rumble was heard" and for the first few beats "a short crescendo." These sounds may perhaps be considered as lesser manifestations of the stenosis murmur, appearing either with lessened blood flow through the valve orifice or under conditions unfavorable to the transmission to the chest wall of the vibrations producing the sound. Their presence should always make us suspect a lesion and should call for further careful search for the characteristic signs.

What then shall be said of the cases in which even in the favorable positions we hear only one or more of these lesser manifestations of the murmur? There are 10 such in this series, 5 of which showed no other abnormal physical signs, 3 had mitral regurgitation and 2 had aortic regurgitation. In this group of 10 the same four positions appeared most favorable, as appeared so in the group considered to surely have the lesion, the murmur being either louder or more typical of mitral stenosis in these positions. The dorsal positions, however, instead of being neutral were distinctly less favorable.

Although it seems quite reasonable to me, in view of the facts of this investigation, to view these sounds as an evidence of an early stage of the lesion, I do not think we are ready yet to base a diagnosis upon them when they occur alone. Cases showing only these signs should be followed for a long enough time to be sure that they do develop the typical signs of the disease, or autopsy should show a mitral narrowing when only such signs are present, before we shall be able to accept them as diagnostic. Attention is called to the occurrence of these atypical sounds in the hope that many such observations may be made.

There has been no additional light from this investigation upon the always difficult problem of separating the diastolic murmurs heard at the apex in the presence of aortic regurgitation into a group due to mitral stenosis and a group due not to mitral stenosis, but to the Flint mechanism. It must be emphasized that the blowing, fine quality of the murmur of aortic regurgitation, is not heard either in the Flint murmur or in the mitral stenosis, and, moreover, the pitch of the aortic regurgitation murmur, is always a higher one than is ever reached by the other two. Of the 16 cases which have both aortic regurgitation and the apical rumble all but

4 were considered to have mitral stenosis because of the presence of accessory signs of this lesion; 2 of these 4 were indeterminate cases and 2 were considered to be instances of the Flint murmur. These 4 cases showed the same type of variations in the apical murmur, with posture and exercise, as did the cases of mitral stenosis.

AORTIC REGURGITATION. For the diagnosis of aortic regurgitation we have demanded a more or less prolonged, blowing murmur much like the swish of a rocket heard very faintly, but tending to diminish rather than to increase in intensity. It may rarely have a musical quality like a fife. This murmur begins immediately after the second heart sound, and nearly always lasts through until the first sound, though it may fall somewhat short of it. It may be very faint, and since it is not well transmitted by the bell of the ordinary stethoscope, it will be often missed if this is the only means of auscultation used. The direct stethoscope and the diaphragm type of stethoscope, such as the Bowles, transmit this murmur better than the ordinary instrument, but neither of them better than the ear laid directly upon the chest.

The area of maximum audibility of this murmur may be a very large one at the base or may be very restricted. It may be in the second, third, fourth or fifth intercostal spaces on either side of the sternum or over the sternum itself. In this series of 19 cases the *area of maximum audibility* in the erect position was:

Fourth left interspace	11 times.
Third left interspace	8 times.
Second right interspace	6 times.
Fifth left interspace	1 time.
Sternum at level fifth interspace	1 time.

There were 3 cases in which the murmur was heard in the erect position only with the direct ear and not with the ordinary stethoscope. Of these 3 cases the murmur was heard in 1 only in the second right interspace, in another only in the third and fourth left interspaces and in the third in all three of these places.

As to accessory signs of this lesion which will be helpful when the murmur is difficult to hear, it must be said quite emphatically that there are none reliable. The Corrigan or water-hammer pulse, increased pulse-pressure as measured by the sphygmomanometer, capillary pulsation, a heaving apex impulse, these things are found in cases with plainly developed murmurs, but I recall no instance in which they were present when the murmur was so faint or so atypical that there was any doubt as to the lesion. Certainly they alone without a murmur should not be made the basis of a diagnosis, and it must be remembered that any of them may occur from other causes than this valve lesion.

Comparing the murmur heard in the erect position in these 19 aortic cases with that heard under the other conditions of examina-

tion, in regard to whether the other conditions rendered it more or less loud, it was found:

	Louder.	Same.	Less.
When erect with forced expiration	16	3	0
With trunk bent forward	18	1	0
In dorsal prone position	2	4	11
In dorsal prone with forced expiration	7	3	8
When lying turned toward left side	2	7	9
After exercise in erect position	14	2	0
After exercise: when turned on left side	5	1	5

In this lesion we are concerned only with loudness of the sound—ease of hearing—it is not as with mitral stenosis a question of the quality or character of the sound for this scarcely changes. Here the favorable positions are quite apparently the bent forward position, the erect position with forced expiration and the erect position after exercise. It seems likely that the bent forward position after exercise would be still better, but unfortunately this was not investigated. The dorsal position and the left lateral positions are evidently unfavorable.

The series included cases with all grades and intensity of the murmur, from the faintest which could be heard, to a very loud, harsh blow heard all over the body of the heart and at the apex. A relation was noted between the loudness of the murmur and the area at which it was heard, the fainter murmurs not being heard in the third, fourth or fifth right interspaces or in the second or fifth left interspaces. As the faint murmurs were made louder by position or by exercise the area of audibility is increased in a more or less radial direction from the original area.

It may be noted in passing that 6 of the cases had a harsh systolic murmur at the aortic area, and in 2 of these 6 a systolic thrill was felt both there and in the vessels of the neck. These 2 cases, having also a small arterial pulse wave with a blunt peak, were considered to have *aortic stenosis*. In both of these the thrill was much plainer after exercise and in the bent forward position. One of the cases of aortic stenosis showed an accentuation of the second sound at the aortic area as did four other of our cases of aortic regurgitation. This is mentioned only in order to emphasize the fact that to find an accentuation of the second sound at the aortic area must not be considered as evidence against the presence of aortic regurgitation.

SUMMARY. The best conditions for hearing the murmur of mitral stenosis are present after exercise and especially when lying on the left side after exercise. Without exercise the left lateral and the bent forward positions are by far the most favorable. The dorsal position is better than the erect in about 45 per cent. of the cases, though in 36 per cent. it is less favorable. All of these positions should be used in listening to doubtful cases, and especially the

positions after exercise, without which a negative diagnosis should not be made.

The crescendo murmur is not present in all cases of mitral stenosis, but is best elicited by the left lateral position after exercise. It may be present for the first few beats only, even under these conditions. A case which develops a crescendo murmur may show either a long rough diastolic rumble or a low-pitched hum in the positions in which the crescendo is absent. Either of these may be loud or faint but as a rumble becomes faint it tends to change its character and to become a hum, while a hum when it becomes louder changes to a rumble. There may be even less abnormal sound during diastole than these; perhaps only a short sound like the third heart sound, or perhaps no diastolic sound at all. The first heart sound may or may not be prolonged. In fact in any one position, and especially in the erect position, some cases may show nothing at all to suggest mitral stenosis, yet in the more favorable positions a typical combination of murmurs may develop. This observation is very important in its bearing on the diagnosis of early cases.

These variations of the murmur with position should also be carefully borne in mind in following the progress of individual cases over a period of months or years. Each examination should be made under the same conditions or the quality of a murmur cannot be compared from time to time, nor can any importance be placed upon the appearance of a murmur for the first time when one of the more favorable position is first used. It is suggested that these diastolic sounds may be the earliest evidence of mitral stenosis, and that they may progress with a progression of the lesion in the order named in the text, and in a way similar to that in which their character progresses as more favorable positions are used.

The best conditions observed for hearing the murmur of aortic regurgitation were the erect bent forward position, the erect position in forced expiration and the erect position after exercise. It seems probable that the bent forward position after exercise would be better still than any of these. This murmur varies only in intensity and not in quality. At times it is not heard with the ordinary stethoscope but can be heard with the ear directly against the chest wall. A negative diagnosis should never be made unless direct auscultation is used. Very faint murmurs due to aortic regurgitation were heard near the sternum in the fourth left interspace, the third left interspace or the second right interspace, and these three areas in the order named were the most common areas of maximum audibility of the plainer murmurs.

As a whole, then, these special procedures for examination have proved to be decidedly valuable in the recognition of early or obscure cases of valvular disease. There is a certain variability from case to case as to which position will give the optimum result, but, in general, exercise and the left lateral position are most favorable for

mitral stenosis and the bent forward position for aortic regurgitation, while direct auscultation is indispensable for the fainter murmurs of the latter lesion. The use of the different positions is very instructive to the examiner, giving him an idea which cannot be obtained otherwise of the degree of disturbance of the blood currents in the heart. This is particularly the case with mitral stenosis, and certain minor abnormal diastolic sounds are pointed out which are believed to presage the more typical murmurs of this lesion.

A COMPARISON OF MEDICAL CASUALTIES IN BRITISH AND AMERICAN TROOPS AT A GENERAL HOSPITAL IN FRANCE.

BY REGINALD FITZ, MAJOR, U.S.A.M.C.,

BOSTON, MASSACHUSETTS,

AND

ALICE CUNNINGHAM,

SECRETARY, UNITED STATES ARMY MEDICAL DEPARTMENT.

(From the Medical Division of United States Army Base Hospital No. 5.)

ON November 1, 1917, United States Army Base Hospital No. 5 began to act as a British General Hospital in Boulogne, and at first dealt exclusively with British soldiers. After January 1, 1918, certain newly landed American divisions were brigaded with the British in Flanders and Northern France, from which general area all the patients were drawn, and therefore numbers of their sick were also sent to this hospital. These Americans in the field, though not actually in the trenches as much as the British, were given British rations, lived under British sanitary conditions and worked according to the same general plan as did the British. Thus a chance arose of comparing in the same hospital and at the same time the diseases which were most prevalent among two widely different groups of soldiers who were living together in the same way, the British representing older men, well accustomed to the climate, food and surroundings, the Americans being younger and entirely unused to their environment.

The following paper reports a statistical comparison of the common diseases occurring in 3643 of the British and 1696 of the American medical cases seen in United States Army Base Hospital No. 5 from January 1 to December 1 of the year 1918. These figures included all the American sick who were admitted during this time. About twice as many successive British admissions were considered each month, as their number were much greater. In this way seasonal variation of diseases or epidemics in both armies

were included and a fair comparison was obtained of the most prevalent types of disease among the two groups of men as a whole. The tabulated diagnosis was made in each case after necessary observation and study.

Twelve well-defined and frequent types of disease were met with: (1) Fever of undetermined cause, largely of the trench-fever type; (2) infections of the upper and lower respiratory tract; (3) diseases of the ear; (4) pulmonary tuberculosis and pleurisy, with or without effusion; (5) gastro-intestinal disease, including typhoid fever and dysentery; (6) venereal disease; (7) scabies; (8) nephritis; (9) casualties due to fatigue and exposure, such as are labelled myalgia, debility or neurasthenia; (10) diseases of the heart, including valvular disease and "D. A. H.," (11) arthritis, with definite pathological changes in one or more joints; (12) cerebrospinal meningitis. In addition there were isolated cases of cancer, mumps, scarlet fever, diphtheria, herpes zoster, tape-worm and other diseases of one sort or another, which were so rare as to be negligible. A summary of the important features of this study is given in Table I:

TABLE I.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Infections of the upper and lower respiratory tract	1269	345	783	461
Fever, cause undetermined, largely trench fever	1102	310	153	90
Fatigue	361	97	136	81
Gastro-intestinal disease, including typhoid fever and dysentery. ¹	344	94	329	194
Nephritis	212	57	8	5
Heart disease, including valvular disease of the heart and "D. A. H."	161	44	43	25
Pulmonary tuberculosis and pleurisy	97	27	77	45
Diseases of the ear	45	12	37	22
Arthritis	22	6	80	48
Scabies	15	4	18	11
Venereal disease	12	3	28	16
Cerebrospinal meningitis	3	1	4	2
Total	3643	1000	1696	1000

One of the most striking points of this comparison was the prevalence of trench fever and nephritis among the British and the uncommonness of these diseases among the Americans.

¹ As will be pointed out, the apparent relative infrequency of typhoid, dysentery, scabies and venereal diseases among the British admissions was in large measure due to the fact that these cases were sent direct to isolation hospitals as soon as the diagnosis was made and did not pass through general hospitals.

TABLE II.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Fever, cause undetermined, largely trench fever	1102	310	153	90
Nephritis	212	57	8	5

As can be seen, about 31 per cent. of the British medical casualties were due to trench fever and 6 per cent. to nephritis, while only 9 per cent. of the American casualties were due to trench fever and 0.5 per cent. to nephritis. It has been shown that the virus of trench fever is transmitted by lice, and it has been suggested that the cause of trench nephritis, as well, is a lice-borne infection. The Americans were as much exposed to lice as the British, and as much bitten. Their apparent immunity to both diseases as contrasted with the British susceptibility is remarkable. The underlying reason, probably, is because the Americans were billeted in areas where infected lice were found in small numbers and where the number of trench fever "carriers" was so small as to prevent any general infection of the lice. Thus the vicious circle was interrupted. Had the Americans stayed long enough in infected areas to develop the disease, and in turn to infect large numbers of lice, it is probable that they would have developed both trench fever and nephritis to a greater extent.

Infections of the lower respiratory tract caused a large number of the sick from both groups of men.

TABLE III.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Influenza	724	196	448	265
Acute and chronic bronchitis	270	74	157	92
Bronchopneumonia	40	11	26	15
Lobar pneumonia	62	17	51	30
Total	1096	298	682	402

Table III suggests that respiratory infections were a commoner source of medical casualties among the Americans than among the British. If the figures are analyzed in greater detail the following points are brought out:

TABLE IV.

Disease.	British.		American.	
	Actual number.	Number per 1000 cases of respiratory infection.	Actual number.	Number per 1000 cases of respiratory infection.
Influenza	724	660	448	656
Acute and chronic bronchitis . .	270	246	157	230
Bronchopneumonia	40	36	26	38
Lobar pneumonia	62	58	51	76

Influenza was common among both the British and Americans and caused an equal percentage of the admissions due to respiratory diseases as a whole. Acute or chronic non-influenzal bronchitis was a second large factor in this group of diseases and was slightly greater among the British than among the Americans in part, because chronic bronchitis and emphysema were found in a number of old British soldiers and was rare among the Americans.

Pneumonia of either the broncho or lobar type and following influenza caused all the deaths in this series. Since pneumonia was only seen sporadically and infrequently before the first wave of the 1918 influenza epidemic developed, the cases of influenza, broncho- and lobar pneumonia were considered together.

TABLE V.

Disease.	Actual number.	Number per 1000 cases of influenza; broncho- and lobar pneumonia.	Total deaths.	Deaths per 1000 cases of influenza; broncho- and lobar pneumonia.	Deaths per 100 cases of broncho- and lobar pneumonia.
BRITISH.					
Influenza	724	877			
Bronchopneumonia . .	40	48			
Lobar pneumonia . .	62	75	23	28	22
AMERICAN.					
Influenza	448	853			
Bronchopneumonia . .	26	50			
Lobar pneumonia . .	51	97	31	59	40

This table shows that bronchopneumonia followed influenza in about 5 per cent. of both British and American cases; while lobar pneumonia occurred in about 7 per cent. of the British and in 10 per cent. of the American cases.

The total mortality of the British due to influenza averaged nearly 3 per cent. while that of the Americans averaged 6 per cent. The British mortality of the postinfluenzal pneumonia cases alone was 22 per cent. against an American mortality of 40 per cent. Thus it seemed that the Americans developed more pneumonia as a com-

plication of influenza than did the British and suffered twice as high a death-rate.

Gastro-intestinal and venereal diseases and scabies may be considered as theoretically preventable diseases; they were seen much oftener among the Americans than among the British.

TABLE VI.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Diarrhea	177	48	139	83
Gastritis	91	25	64	38
Appendicitis	50	14	76	45
Dysentery	11	3	33	19
Jaundice (catarrhal)	14	4	11	6
Typhoid group	1	..	6	3
Venereal	12	3	28	16
Scabies	15	4	18	11
Total	371	101	375	221

There are various reasons for the apparent difference shown in Table VI. The British soldiers were used to their rations, whereas the Americans found the food different from that to which they were accustomed, and disliked it. As a result they ate food and drank water which was outside that issued, and which probably caused such forms of indigestion as diarrhea, gastritis or catarrhal jaundice. Many men were admitted from both armies with histories suggesting mild appendicitis, but who were well at entry. The diagnosis of this disease, however, was made more frequently among the Americans than among the British, because, apparently, American physicians are less conservative in regard to this diagnosis than are the British. Finally, the results of the table are misleading because, according to British regulations, cases of dysentery, typhoid, venereal diseases and scabies were discovered as early as possible and were sent at once to special hospitals. It is probable that the newly arrived American medical officers in advanced areas did not know the proper channels through which the men should have been discharged, thus sending cases to a general hospital from field or evacuation hospitals which should have gone elsewhere.

An interesting impression given by the Americans was that any inherent tendency to disease which any one of them might have was stimulated by such a sudden and complete change of method of life as the one to which they were exposed. This is illustrated by comparing the occurrence of pulmonary tuberculosis with positive sputum and of infectious arthritis in the two groups.

TABLE VII.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Pulmonary tuberculosis with positive sputum	22	6	27	16
Infectious arthritis	22	6	80	48

According to regulations both sets of men had been examined carefully before joining the army. Yet pulmonary tuberculosis was found nearly three times as frequently among the Americans as among the British. The histories of the men showed that many of them had had pleurisy several years before—that until coming abroad they had felt well in every way—but on arrival in a strange country and surroundings had suffered an acute flare-up of their latent disease.

The difference in occurrence of true arthritis with involvement of one or more joints was even more striking. It was rarely seen among the British but was common among the Americans. In many cases the arthritis was a recurrence of acute articular rheumatism which had been latent for a long time but which the trip abroad seemed to awaken.

The remaining common illnesses are grouped together for easier comparison.

TABLE VIII.

Disease.	British.		American.	
	Actual number.	Number per 1000 casualties.	Actual number.	Number per 1000 casualties.
Myalgia, fatigue, debility and neurosis .	361	97	136	81
"D. A. H."	156	43	36	21
Valvular heart disease	5	1	7	4
Ear disease	45	12	37	22
Pleurisy with or without effusion . . .	75	21	50	29

The number of patients who were merely tired out or who had some form of neurosis was greater among the British than the Americans. Closely related to this group was the D. A. H. or "effort syndrome," which was doubly large among the British. The obvious explanation is that the Americans, who were all fresh troops, had not had time to develop such manifestations of fatigue. Valvular disease of the heart, due to faulty physical examination at entry to the army, was discovered oftener among the Americans than among the British, but was rare. Ear disease, usually as acute or chronic suppurative otitis media, was more frequent among the

Americans. This was in part, probably, because of the relatively greater frequency of respiratory infection among them, as during 1918 inflammation of the accessory sinuses and ears was a not uncommon accompaniment of influenza and bronchitis.

Finally, pleurisy was seen about equally often among the two groups. Pleurisy with effusion, however, was unusual among the British as compared with the Americans. This fact can be used as another example of the tendency shown by latent disease in the Americans to flare up upon arriving in France.

There seems no more logical reason than the one offered to account for the fact that the Americans should have been so immune to trench fever and trench nephritis, as they were as much exposed to lice and to cold and wet as were the British. Probably had they remained long enough in areas in which infected individuals and lice were prevalent they would have suffered as much as did the British. The differences in diseases otherwise can be explained, in part, by comparing the military experience and mental reactions of the two groups.

There was a striking difference in the make-up of the patients as considered from the point of view of age and length of military service. In a group of 1000 British soldiers from these statistics 619 were less than thirty years old and 381 were over thirty. Of an equal number of Americans 872 were less than thirty years old and only 128 were over thirty. Of the British, 739 had been in the army in England or France for more than two years, while of the Americans only 60 had been in the army for more than two years; 385 of the British had been in France for less than one year and 971 of the Americans had been in the country for less than one year. Thus the British patients were much older, both as men and as soldiers, than the Americans, and more of their constitutionally unfit had been weeded out. They also had the benefit of experience and knew how to care for themselves better than did the Americans.

As great a difference was found by comparing 100 British sergeants with an equal number of American sergeants in the same way. Of the British sergeants 61 were less than thirty years old, none had been in the army for less than two years and 70 had been in France for more than two years. Of the Americans 81 were less than thirty years old, only 31 had been in the army for more than two years and 90 had been in France, less than six months. Thus the responsible British non-commissioned officers were most carefully picked and experienced men, while the Americans, because of insufficient material and the urgency of the situation were not. No figures were available for comparing the experience of individual battalion medical officers, but presumably the Americans were at an equal disadvantage. General sanitary orders and regulations therefore could be enforced far more easily among the British than among the Americans.

Finally, the British and American mental attitude toward their work seemed different. The British patients gave the impression of being, on the whole, self-contained, sober-minded men. The Americans in contrast were irresponsible boys to whom the adventure of coming to the war appealed strongly, and as a result they were casual in regard to their own care of themselves, taking every liberty with the general common-sense laws of personal hygiene.

From this comparison of medical casualties which were seen at a base hospital it appeared that the younger and less acclimatized American troops reacted in their development of diseases differently from the older and more seasoned British soldiers. Each body of men tended to have the same common illnesses but in different proportions. The British had many cases of trench fever and trench nephritis. These diseases were comparatively uncommon among the Americans. Respiratory infections and especially those following influenza, were more common and more serious among the Americans than among the British. The Americans had more casualties from diarrhea and indigestion, while the British suffered more from casualties due to physical strain and fatigue. Finally, the Americans more than the British seemed to develop an acute exacerbation of any chronic or latent disease to which they had any tendency from inheritance or previous history. These differences were due, among other reasons, to the fact that a certain number of men constitutionally unfitted to military life had not been weeded out from the Americans at the outset, and that there were too few officers and non-commissioned officers who were trained to enforce the disciplinary and hygienic measures designed to keep medical casualties as small as possible.

OPERATION OF SPINAL DECOMPRESSION.

BY NORMAN SHARPE, M.D.,

NEW YORK.

THE operation of laminectomy for "spinal decompression" in cord lesions has a place in surgery comparable to that of cranial decompression in lesions of the brain. The value of operation for cranial decompression, especially that of subtemporal decompression in supratentorial lesions, has been well recognized for years. That laminectomy for spinal decompressions or for exploration is of equal if not greater value is not yet generally appreciated. It has in the past been employed but rarely, and then usually at the wrong time, and as a last resort when all other measures have failed and the nerve tissue irreparably damaged. And yet there can be no

doubt that in patients having obscure lesions of the cord or in doubtful diagnoses an exploratory laminectomy, frequently terminating as a simple decompression, has been followed by remarkable improvement of the patient. The spinal operation has an advantage over the cranial decompression, for though a cranial decompression may be used for an exploratory procedure the lesion itself can rarely be removed through the original incision; so that a second operation, the formation of an osteoplastic flap, is frequently necessary. But in spinal laminectomy the major part of the cord at the supposed site of the lesion is before the eye of the operator for exploration, and spinal decompression, exploration and possible removal of a lesion can be carried out at the one operation. Furthermore, diagnosis and localization of cord lesions is more accurate than the lesions of the brain. With the advance in surgical technic of recent years spinal laminectomy for exploratory purposes is becoming more and more recognized as justifiable and of small risk.

It is the purpose of this paper to discuss the value of exploratory laminectomy in cases of doubtful diagnosis or lesions of obscure origin which can be localized, and the value of spinal decompression in certain selected cases of well-recognized forms of cord disease which formerly were not considered amenable to surgical interference. Fractures of the spinal column with loose or depressed bone fragments and extramedullary tumors have for years been subject to operation and will not be considered in detail.

RECENT FRACTURE. In recent fracture of the spinal column, with involvement of the cord, laminectomy is urgently indicated even though there is no evidence that bone fragments are compressing the cord substance. An early decompressive laminectomy will allow the removal of blood clot, but, what is more important, will avoid the compressive effect of edema in and about the cord, which is always present, and sometimes in large amount, after every trauma to the cord. By laminectomy is meant operation after the patient has recovered from the shock, twelve to thirty-six hours after injury. Of course, laminectomy should not be considered while the patient is in a condition of shock.

Naturally a simple bone decompression with opening of the dura will be of no avail to the cord fibers already destroyed by the trauma. But by removal of hemorrhage and edema by an early laminectomy the sound fibers and many of the damaged ones will be preserved which otherwise would be destroyed by the compressive effect of the edema. In the past the harmful effect of compression by edema in cord trauma has been overlooked. In several cases of fracture of the spine operated upon by the writer by early laminectomy the cord (which normally lies loosely within the dura) was so swollen and tense with edema and filled the dural sac so completely that it was necessary first to incise the dura at a point well away from the site of injury and allow the fluid to escape. This was necessary not only

to avoid injury to the swollen cord by direct incision but also to prevent a possible extrusion of cord substance through the dural incision if made directly over the point of swelling. No one who has encountered a condition such as this could fail to be convinced that if not relieved by operation such intense compression, even though by fluid, must cause severe damage not only to the injured fibers but also to the normal ones.

That edema alone can cause severe compression of cord fibers was well demonstrated in experiments carried out on animals by the writer some years ago in an effort to determine the primary causative factor in spina bifida.¹ Through a small laminectomy wound at the cervical dorsal junction in rabbits and puppies salt solution in variable quantities was injected under the spinal membranes both by gravity method and by syringe at moderate increasing pressure. Escape of fluid upward was prevented by cotton pledgets. Shortly after the entrance of the salt solution there were signs of irritation in the lower extremities (jerking and twitching of hind legs), followed as more fluid was introduced, by paresis of the legs in varying degree in the different animals; in two cases this amounted to apparent total paralysis. As the experiments had a different objective in view (the formation of a spina bifida protrusion in the lower lumbar region), and the animals were chloroformed at the end of the experiment, there was no opportunity of learning whether restoration of function in the hind legs would have followed absorption or withdrawal of the salt solution. But leaving aside the severe paralysis caused by the injection of large amounts of the solution the irritation and paresis caused by the introduction of fluid under moderate pressure in a normal cord are indicative of the damage edema can produce on injured cord fibers and how it continues and augments the initial lesion or trauma.

OLD FRACTURES. There are many patients with fracture of the spinal column and trauma of the cord on whom, for various reasons (failure to diagnose the fracture, refusal of operation by the patient and the still rather widely held opinion that early laminectomy accomplishes no good), no operation was performed. In many of these patients improvement later occurs, progresses in variable degrees and then ceases, the condition becoming stationary, with the patient more or less disabled. In others, following the initial improvement, retrogression sets in, the condition becoming steadily worse. In yet other cases (and these usually the ones of moderate injury) the initial improvement is slight or absent, and the signs of cord involvement become progressively pronounced. In a large proportion of these patients the roentgen rays will disclose no displacement or thickening of bone and operation, if undertaken, will confirm the negative roentgen-ray findings. And yet in many of

¹ *Annals of Surgery*, February 1915.

these old cases of fracture a simple exploratory or decompressive laminectomy will often give astonishing and brilliant results. Then what was the cause of the disability? The initial injury, undrained hemorrhage in or about the cord, the formation of later scar tissue and adhesions about the cord and in the arachnoid and dura that lead to the formation of sacculations filled with fluid. I have seen patients in whom the arachnoid adherent at some points and with fluid-filled sacculations at other points had the appearance of multilocular cysts. This condition alone, by compression, is capable of giving rise to marked signs of cord impairment. When such a condition is encountered the arachnoids should be widely opened, adhesions divided to allow the proper flow and return of spinal fluid and to prevent sac or cyst formation. Under no circumstances should the attempt be made to dissect scar tissue from the cord. If this is attempted the condition will almost certainly be aggravated. As stated above, remarkable improvement will often follow an exploratory laminectomy even in those patients with old fracture of the spine. Two such cases were reported in a former article.² One of these, a coal miner who suffered a fracture in the lower spine from a fall of rock, had been an invalid for eighteen months, able only to get about with crutches. Six months after an exploratory and decompressive laminectomy he was able to do desk work, using neither crutches nor cane. He continued to improve so that two years after operation he returned to his work as a miner. Six months later he was killed by a second fall of rock.

The condition of increased intraspinal pressure (due to accumulation in excess of cerebrospinal fluid), similar to the corresponding condition intracranially, is the one lesion above all others of the nervous system that can be most successfully and safely treated by surgical means. Strictly speaking, increased pressure, whether intracranial or intraspinal, is not an independent lesion or clinical entity, but is rather secondary to some underlying lesion. Yet it is so frequently met with, its power to damage the nerve cells and fibers so great, the signs of its presence so readily ascertainable and its removal so promptly followed by improvement, as almost to raise it to the dignity of a distinct disease entity.

MULTIPLE SCLEROSIS. That disseminated sclerosis, with its widespread and multiple lesion scattered throughout the white areas of the cord and brain stem, could be benefited by surgical intervention may well be doubted. And this is true in typical cases in which the optic disk pallor, nystagmus, tremor of hands, absent abdominal reflexes and spasticity of legs bear witness to the widespread nature of the disease. There are other cases of multiple sclerosis in which the signs point to a focussing of the disease process in the lower part of the cord, as shown by the greatly exag-

² AM. JOUR. MED. SC., December, 1916, No. 6, clii, 865.

gerated tendon reflexes and marked spasticity of the legs and a definite increase of fluid at lumbar puncture and comparatively little involvement of the upper part of the brain stem, as disclosed by little or no tremor of hands, no nystagmus and absence of pallor of the optic disks. And in certain cases of this latter type remarkable improvement has followed a simple laminectomy. Some of these patients show a definite sensory level zone about the lower thorax or abdomen, leading to the assumption that we are dealing perhaps with a cord neoplasm. Indeed, the first of these cases reported below was operated on with that diagnosis in mind, and it was only after the dura was opened that the condition was recognized as multiple sclerosis. Improvement was so definite that the two following cases of undoubted multiple sclerosis of the edematous type just described were operated upon with positive improvement in one case and slight in the other. We have operated upon four such cases, two of which show definite improvement, the third an astonishing result, in that whereas the patient came into the hospital markedly disabled on crutches, he walked out three weeks following a decompressive laminectomy with a cane only. His present condition after two and a half years is definitely improved. The fourth case was one in which the sclerotic process followed severe trauma to the lumbar spine some years before and the roentgen rays disclosed marked thickening of the vertebral laminae. He was operated upon because of the roentgen-ray findings rather than for multiple sclerosis. No improvement whatever followed.

While we cannot be positive as to the etiology of multiple sclerosis, there is much evidence to support the view that the predisposing cause is faulty metabolism, an absorption of toxins, probably of intestinal origin. Trauma to the spine, perhaps slight in character, may be regarded as the exciting cause, for the signs of the disease rather often follow closely upon the receipt of an injury and make their first appearance in the neighborhood of the trauma.

But whatever the cause the pathology of multiple sclerosis would lead us to doubt strongly that in the presence of a disease process so widespread and deep-seated in the cord, possible benefit could result from the creation of a gap in the bony canal and membranes by a simple laminectomy; and yet in view of the above and other reported cases it is not possible to doubt but that in certain selected patients having multiple sclerosis a decompressive laminectomy is followed by definite and marked improvement. Whether this improvement is due to the removal and subsequent subcutaneous wound drainage of cerebrospinal fluid, which was found to be far in excess of normal in all the above cases, or whether there is a real modification of the sclerotic patches by alteration of the blood supply following operation, is impossible of verification. In two of the above cases the cord was somewhat shrunken in size, and in all four there was an excess of fluid. Yet the fluid soon recollects. In

the writer's opinion improvement was caused by increased nutrition of the cord due to alteration in the blood supply. That the improvement following decompression operations in multiple sclerosis is or will be permanent is open to question. Unless in an early exceptional case, it is difficult to conceive that such a measure will be followed by the disappearance of the sclerotic patches with restoration of function. Yet the improvement in the patients referred to above and in other patients has been so definite and relief so marked that even were the relief to last only two or three years the operation would, in the writer's opinion, be a valuable procedure in the face of the increasing spasticity and disability.

SYRINGOMYELIA. Syringomyelia is characterized by cavity formation within the cord, about the central canal. The basis of the process is a congenital anomaly of development affecting the central canal or nests of glia cells persisting from fetal life, remaining quiescent for years and under the influence of some irritant, proliferating with first tumor and later cavity formation about the central canal. The disease process is usually located in the cervical and upper dorsal region of the cord and is slowly progressive, extending in a longitudinal direction, and gives rise to marked and well-defined motor and sensory impairment. Trauma of the spinal column very frequently precedes the formation of syringomyelic cavities, which may become filled with fluid, compressing the cord substance and giving rise to severe sensory and motor impairment. Trauma of the spine also very frequently precedes the formation of tumor of the cord either intramedullary or extramedullary, while in frank, typical cases syringomyelia and cord tumor can be rather readily differentiated, yet in atypical conditions, such as a lateral position of the tumor or a sharply localized position of the syringomyelic cavity it may be impossible to make a positive diagnosis. Naturally, if the diagnosis is tumor, the only procedure possible is operation; and if at operation instead of tumor the condition is found to be a syringomyelic cavity distending the cord the proper procedure is to drain the cavity and keep it drained by a method described below. Indeed, in certain cases of well-developed syringomyelia in which the signs point to the existence of a single cavity which does not involve the bulb, as in the lower cervical or upper dorsal region, and when the increasing intensity of the symptoms point to progressive distention of the cavity with fluid rather than to a spread of the disease process, it is, in the writer's opinion, justifiable to operate for the drainage of the cavity. One such case operated upon two and a half years ago had flaccid atrophic paralysis of both arms and spastic paralysis of the legs, with dissociated sensory disturbances. Impairment was such that the arms were almost useless, hanging loosely at the side, and he walked with difficulty. Laminectomy was performed in the lower cervical region and a funnel-shaped enlargement of the cord found extending from the fifth

cervical to the first dorsal segments inclusive. A longitudinal incision of the cord in the midline allowed much fluid to escape; the cavity was over two inches long and about one-third inch in diameter. Fine strands of linen thread were introduced into the cavity and the ends carried upward through the laminectomy wound and implanted in the muscle. Improvement was observed before the patient left the hospital. He continued to improve during the first year following the operation, in that he was able to raise the arms to the head, comb his hair, feed himself, etc., but never gained the power of raising the arms above the head. He walked with a less spastic gait. Since then his condition has remained stationary.

Naturally, operation is not advised in all cases of syringomyelia, especially when atrophy is extreme, but only in those patients in whom the medulla is not involved and in whom the signs point to the existence of a single cavity, with increasing distention of fluid—in short, in the selected patients described above. Whether the relief obtained will be permanent is doubtful. Certainly, the marked improvement this patient has shown for two and a half years makes the operation a justifiable one in selected patients.

UNCLASSIFIED CASES. In addition to these well-defined conditions of spinal-cord disease or lesions, which may be benefited by operation, cases of cord involvement are seen quite frequently, in which only a tentative or possibly no diagnosis can be made. The obscure origin of the lesion or the unusual nature of the cord symptoms may make a positive diagnosis impossible. Naturally, if improvement occurs shortly and steadily progresses operation would not be considered. But if the signs of cord impairment remain stationary or further impairment occurs an exploratory laminectomy is not only justifiable but is imperative, even though the nature of the lesion cannot be diagnosed. Though in some of these patients operation will disclose a condition that will not be benefited the risk of the operation is slight. In other patients decided benefit and at times brilliant results will be obtained. The history of the following case is interesting as illustrating the observations noted above:

S. G., aged thirty-one years, cabinetmaker. In September, 1917, a small abscess appeared in the left nostril and was incised. During the following three months abscesses appeared in succession in the left orbit, the left cheek and the left side of the neck back of the ear. The last abscess was not healed until January, 1918, at which time he complained of pain and stiffness of the neck. A diagnosis of cervical Pott's disease was made and the head and neck immobilized by a stiff brace, which he wore for six months. In June, 1918, five months after the brace was applied, he noticed a numbness of the right hand and weakness of the left arm and hand. In one month this had progressed to a left hemiplegia (face not involved), with

sensory disturbances over the right half of the body (excluding the face). The condition was now diagnosed as luetic bone disease of the cervical vertebræ. Two blood Wassermanns at this time were negative, and later two blood Wassermanns and one spinal fluid Wassermann were also negative. Notwithstanding these findings salvarsan was given intravenously; no benefit followed. Two radiographs in July showed no apparent bone lesion. Seen by the writer in November, 1918, examination showed a left hemiplegia. He walked with difficulty, the legs being very spastic; left ankle-clonus and a left Babinski were present. The left arm also was spastic. Could raise the arm slightly and flex and extend the forearm slowly, but could not move the hands or fingers. On the right side there was tactile, thermal and pain hypesthesia on the inner side of the foot, leg, and in areas over the right thigh and trunk; marked hypesthesia of the right hand and in areas over the forearm; no total anesthesia. Two radiographs of cervical spine at this time showed apparently normal bone. As signs and symptoms were stationary an operation was not considered advisable at this time, and he was kept under observation. In January, 1919, he complained of beginning weakness of the right hand and arm, and an examination confirmed this. The right-sided sensory disturbances were unchanged. There was some tenderness to pressure in the left side of the neck at the level of the third cervical vertebra. The signs pointed to a lesion, nature unknown, at the level of the third and fourth cervical segments. Examination of the pharynx disclosed a small sinus running downward toward the body of the third cervical vertebra. In view of the beginning motor impairment of the right side of the body an exploratory operation was advised. Laminectomy was performed January 29, 1919. The laminae of the fifth, fourth, third and part of the lamina of the second cervical vertebræ were removed. The dura was tense and deeply indented on the left side at the level of the third vertebra by a small projection of bone (exostosis) into the canal. This was removed and the dura rounded out. There was no evidence of other obstruction in the canal either above or below the field of operation. Dura incised and fluid spurted to a height of seven inches for ten to fifteen seconds despite the fact that both head and trunk were below the level of the incision. The exposed cord appeared normal and a probe passed upward and downward disclosed no intradural obstruction. The dura was reclosed and the wound was closed with one drain. The head and neck were immobilized by a molded plaster-of-Paris splint.

Eight days after operation he moved the left foot and left fingers more freely than for six months. Three weeks after operation he could flex and extend the fingers of the left hand separately and could put his hand on top of the head and walked with less difficulty. Four months after operation he walked well without a cane;

could use the left arm freely almost as well as the right arm, though somewhat awkwardly. Power in the left arm and leg was good and he could use the arm and leg almost normally, though a trifle uncertainly. Could write legibly though poorly. (He was left-handed.) His chief complaint was numbness of both arms and hands, but examination showed very slight hypesthesia. The areas of marked hypesthesia on the right leg were still present. The lower tendon reflexes were still marked, more so on the left side; left ankle-clonus was present, also a left Babinski. He is steadily improving. Even after operation I am unable to make a positive diagnosis of the lesion, but consider the following to be the most probable:

Osteitis of the second and third cervical vertebræ, with inflammatory reaction in cord meninges and retention of fluid, or thrombosis or pressure obstruction of the spinal vessels of the left side of the cord at the level of the second and third vertebræ:

TECHNIC OF LAMINECTOMY.—A vertical incision is made in the median line over the spinous processes. The muscles are incised close to the spinous processes on both sides and the incisions packed with hot gauze. With a broad-bladed periosteal elevator the laminæ are freed of muscles the whole length of the wound and a large self-retaining retractor inserted, which effectually checks venous bleeding and presents a comparatively dry field. The ligaments of the spinous processes are then divided and the processes removed by large special ronguers. The laminæ are rongeured away, laying open the spinal canal and exposing the dura. This completes the first stage of the operation and should be performed rapidly, both to minimize the loss of blood and to afford leisure for the delicate and sometimes tedious intradural procedure. The spinal canal is then explored by means of a probe or grooved director on all sides both above and below the operating field. Naturally, if suppuration is encountered or suspected in the spinal canal, extradural, the dura would not be opened; otherwise the dura is incised and a similar exploration carried out. If a removable lesion is found, as tumor or blood-clot, the dura may be reclosed. If the operation is a decompression one for a known lesion, such as fracture or multiple sclerosis, the dura is left unclosed to permit of decompression. Unless the dura is opened and allowed to remain open, bone decompression will avail nothing. In other conditions also the dura should not be closed, *e. g.*, intramedullary tumor exposed by splitting the posterior columns or for drainage of a distended syringomyelic cavity. The third stage of the operation is the closure of the wound in layers by chromic gut, using care to have the muscle layers well approximated, leaving no dead spaces. I prefer a single drain of rubber tissue running to the depths of the wound for the drainage of wound fluid. This is removed in twenty-four to forty-eight hours. A molded plaster-of-Paris splint will give support to the spinal column and comfort to the patient. There is little or no pain following the operation, and opiates are seldom necessary.

PROMINENT FEATURES OF THE PSYCHONEUROSES IN THE WAR.

By JOHN F. W. MEAGHER, M.D., MAJOR, M.C., U.S.A.,

NEUROPSYCHIATRIST, U. S. A. B. H. NO. 37, ENGLAND; U. S. A. B. H. NO. 214, FRANCE;
U. S. A. GENERAL HOSPITAL NO. 30, PLATTSBURG BARRACKS, N. Y.; CLIN. ASS'T.,
THIRD DIVISION, N. Y. NEUROLOGICAL INSTITUTE; NEUROLOGIST TO
ST. MARY'S HOSPITAL, BROOKLYN, N. Y., ETC.

THE subject of psychoneuroses occurring in soldiers in the great World War has already a voluminous literature. It is not my intention to describe the various psychic, motor, sensory and vasomotor phenomena found in these conditions, but rather to describe some of the features of special interest.

All writers agree that the designation "shell-shock" is an unfortunate one, as it connotes an etiological condition absent in a large number of cases and not a disease entity. The term included all sorts of functional, organic and psychic conditions. Even the term "war neuroses" has no more real reason for being than had the term "railway spine," formerly much discussed in connection with railway injuries and now rarely mentioned. True, the neuroses occur in war, but fundamentally a hysteria or a neurasthenia in war and one in peace are the same, though the color of the symptoms may differ. Practically none of the phenomena observed in this war are absent in a series of cases found in civil life. So it is more correct to refer to them as the psychoneuroses found in war.

I can hardly agree with a well-known English authority when he says he has not seen a true case of neurasthenia in this war. True, hysteria in its different phases has been the much more frequent reaction-type, but neurasthenia has been quite frequent. I have seen a number of cases soon after they came from the battlefield.

I have seen hundreds of cases of neuroses in the seven months after the signing of the Armistice, and from my observations I would say that in these late cases I have found much more frequently a constitutional neuropathic or psychopathic condition than in the cases found during the active period of the War.

The term "shell-shock," first used by Myers in the *London Lancet* in February, 1915, was early objected to by Henry Head, of London, as being inappropriate, representing a mass of unallied nervous conditions. The term, of course, was meant to include only cases of the neuroses.

In my opinion the association of various endocrinopathies has been incidental in the larger proportion of cases. We know that an endocrine disturbance, as a hyperthyroidism, can be made much worse by the horrors of war, and, again, may very well be an important factor in the development of the neurosis; it may act physically, as through the cardiovascular mechanism, blood, etc., and

mentally through the irritability, irascibility, instability, etc., present in these cases. The importance of the endocrine system and the autonomic nervous system, in those cases designated as disordered action of the heart or cardiac neuroses, is of the greatest importance. The physical exhaustion was important in these cases as an etiological factor. There may be, hypothetically, certain physical and chemical secondary changes; of these we know little at the present time.

As to the frequency of the neuroses, hysteria greatly outnumbered the cases of neurasthenia. Personally, I do not accept the views of the French psychopathological school as to psychasthenia, believing that the larger number of these cases are cases of hysteria. This is the view, I think, which is held by most men of the Swiss and Austrian schools. Their interpretation is a much better one, being more analytical and therefore really more explanatory, the former being chiefly descriptive.

The underlying mechanism in the neuroses in war has been easier to study than similar neuroses in peace times, as the subconscious conflicts were much more superficial. This is true of most of the cases excepting the chronic ones, especially those occurring since the Armistice. Their neuroses were related more to peace conditions than to conditions of war.

It is, of course, important to study the soldier's make-up—that is, his ordinary and habitual way of reacting to stimuli, etc. In fact, unless one makes a study of each patient's make-up the symptoms of the disorder will mean but little to him, for the same symptom-complex in various types of personality has different meanings. It is just as important to know this as it is for a man who is building a bridge or a building to know the nature of the material which he is using.

In these cases, especially in the ones accompanied by anxiety, who came to us in the hospitals in France and England direct from the battlefields, we noted that distressing dreams of battle, bombing aeroplanes, etc., were very common. But we cannot agree with one well known authority who stated that the prognosis in these cases was invariably bad. It was if one refers only to their future use as combat soldiers. Most of such cases that I saw made a prompt recovery, but they were not returned to the firing line. The cases we now see in the United States do not, of course, have such terrifying nightmares. The psychological explanation is evident.

Man's ideals as to right, justice, his relations to his fellow-men, toward cruel practices, living like animals, uncleanness, etc., had to be altered, when the objects of the War became paramount. It was necessary for them to forget many of their cultural lessons, and some of them could not do so.

That other factors besides those related to the War and their own ego must be present, is evident from the fact that nearly all

soldiers were able to go through the worst perils and privations of the war without developing any neurosis whatever. One must not, as I have seen done in England, call a simple case of pure physical exhaustion a neurosis of the type which we are discussing. In such cases a few days' rest usually effects a cure.

In nearly all cases of the neuroses anxiety was a prominent feature, not only in pure anxiety states but in conversion hysteria, heart neurosis and cases with a marked hypochondriacal trend. In some patients the entire syndrome was centered about this morbid anxiety.

The lack of sleep, whether from the arduous work in the trenches accentuated by a state of anxiety, or from other causes, was an important factor in delaying recovery. Rest and sleep as we well know are the best means for combating fatigue, there being no direct biochemical means for curing it.

Fatigue may not only be due to physical causes but to various disturbing emotional states—distaste, disgust, resentment, fear, etc.—which are all important factors in its determination. All strong emotions result in some sort of an upheaval and the patients must have an outlet for the energy generated. If retained in the organism the emotion produces symptoms of a neurosis. A sympathetic nervous or an endocrinopathic disturbance often coexists in these cases.

In general, it might be stated, that the soldier with numerous interests recuperates much more rapidly than the man who has little or no interests. The tendency to chronicity is especially noticeable in these latter patients, especially if they were of the indifferent or asocial "shut-in" type, for they had no outlet to their pent-up energy and their introspection and ruminations made their condition worse.

A careful neuropsychiatric examination will rule out genuine cases of cerebral concussion. In speaking of cerebral concussion, I might say that in over half of the hundreds of cases of neuroses which I have seen in this War, in hospitals dealing with psychoneurotics chiefly, the question of being exposed to shell explosion did not enter at all. I have seen many such cases suffering from neuroses who never reached a position nearer the firing line than Liverpool.

In order to understand the neuroses, especially hysteria, one must realize the great dynamic value of an idea, which has intense value to the particular individual. An idea clothed with a great deal of feeling (*affect*) we call a complex. Hysterics react more quickly and more vividly to an idea or a situation that touches or irritates any of their complexes, than do normal individuals. By the subconscious associations operating in hysteria an idea can be transferred into a physical symptom (conversion hysteria). The history, with a careful neurological examination, will show that the condition is not organic in origin. I might add here that I have never seen a

functional paralysis in an officer, though they were moderately frequent in the men. Pure anxiety states are very frequent in officers, however.

The causes frequently given as precipitating the neurosis are often the so-called "last straw"; they are the exciting causes, but not the principal ones. The principal cause or causes one usually has to abstract from the psyche, and this takes time and necessitates a long training in psychological medicine.

One regularly notices that the patient who pays too close attention to his symptoms is thus favoring their progress and continuance. One notices this especially among the inadequate type of patients, and since the Armistice, among that class of patients who do not seem to make a very heroic effort to get well. One wonders about this, and yet there is no doubt about it. The cases of two lieutenants in the Quartermaster Corps, who broke down in France in November, 1918, who were diagnosed neurasthenia in one case and hysteria in the other, and whose conditions were supposed to be due to overwork and not to battle stress, come to memory. They were with a number of other officers whom I brought back from France in March, five months after their illness began, and in June, three months later, they still complained of trivial symptoms of no moment. To me a few factors are always in evidence in such cases.

Besides the neurosis, one nearly always finds some marked psychopathic traits, if not definite psychopathic states; their home relations, financial state, etc., are often anything but ideal; the will to get better is absent. A neurotic patient who really does not want to get better rarely does.

Two symptoms which all medical men have noticed in this War have been stupor and mutism. The mechanism in these cases is usually easy to work out; the object is to shut out the surroundings and its incidents.

The mechanism and the motive for the hysteric's illness is not in awareness; but by treatment the subconscious associations were brought to the surface, and one then had the patient well in hand; the mechanism became clear to him, and the soldier then recovered. For to remain sick after one knew he understood the mechanism, or to refuse coöperation with the physician, would mean that he consciously would prefer his symptoms, and this would constitute malingering. I saw very little malingering during the war, though I observed especially for it, and was on neuropsychiatric boards in the United States before going abroad, where we examined about 105,000 troops. In the past year and a half since then my experiences have been the same. What few cases I have seen since the Armistice who might be put down as malingerers were patients who did not seem to want to get better, and who preferred their present position than to recover and go home. The signs usually mentioned to distinguish the really sick man from the malingerer—

as the drawn facies, rapid pulse, his frankness and desire for expert examination—are valuable, but the really important thing is to carefully observe his attitude and reactions.

It is better and nearer the truth—and the distinction is not unimportant—to say that a malingerer simulates a symptom, whereas in hysteria the symptom is simulated. This is another way of saying that in malingering the symptom is consciously, in hysteria unconsciously brought into being.

The distinction is fine, but there is a great difference between a conscious act, and one brought about by subconscious motives and associations of which the patient is not aware. He certainly is not aware of the relation to the symptoms. Malingerers are nearly always psychopaths. I have never seen a soldier feign insanity, with possibly one exception. This soldier was exaggerating certain psychopathic traits and trends.

In the beginning of the War men like Frederick Mott, the noted London neuropathologist, Sir John Collie and others tried to explain too much on an anatomicopathological basis, which viewpoint later became untenable.

In some patients one saw that the antagonism to the horrors of war was at times conscious. But the important feature is this, that the patient does not realize the connection between his symptoms and the wish to get away from it all. Were the wish a conscious one, and if the patient could justify his wish—at least to himself—there is then no conflict and naturally no neurosis. The soldiers who broke down said they wanted to get better and (during the war) wanted to get back to the fight; and they did. They never consciously wanted to get out of the service.

In all of these patients I took the attitude that the same conflicts would arise again, and they would readily break down again. So in spite of their frequent remonstrances I told them I would transfer them to a non-combatant unit. I never sent one back to the United States, but told them that they would be able to serve their country in the A. E. F. The results were perfectly satisfactory to everyone. In all of them a study of their subconscious psyche, *i. e.*, a study of the content of their dreams and nightmares, the results of association tests, etc., always revealed their real subconscious desires. To tell them of these bluntly would do no good but would be promptly resented; this is especially true of officer patients. But if one brought the facts out in the proper way, they could be accepted and were accepted always without opposition, for I always showed them that it was not exactly unnatural for the instincts of the ego to predominate over the ethics of the species, that the instinct of self-preservation could not be ignored always, nor by everybody.

As in peace times the neurosis furnished a tolerable situation. In these patients a lively instinct of self-preservation, a poor con-

trol over the emotions and a poor will, with various individual subconscious factors, conflicted with their sense of honor, patriotism, duty and their conscious desire to "carry on." This brought on the military disqualifying symptom or syndrome, constituting the hysteria.

There has been a great deal of speculative theorizing on the subject of the neuroses of war which has not made the question any clearer. Thus Sir John Collie writes that most cases of "shell-shock" are due to concussion(?), but that by the time we get them the first pathological changes have disappeared. This assumption is certainly erroneous in the large majority of cases. His ideas are purely descriptive; no attempt was made to get at fundamental causes, and a pathology non-existent was declared to have been present, but was no longer in evidence. Practically none of these cases died, so the pathology is in the psyche and is not a somatic one. He would have done better had he referred to the pathology as being one of morbid anxiety.

Myers refers to certain sensory cases of what he calls "shell-shock," and says the cause might be a thalamic lesion. If there existed a thalamic lesion, it would then have been an organic case and not a neurosis. If the soldier later developed a neurosis then it would have been a secondary and not a primary one. The same criticism applies to Mott's cases, in which he described punctate hemorrhages, emboli, etc., in the medulla and elsewhere. When such conditions are found to exist postmortem, then the diagnosis should be amended and a proper anatomicopathological designation given.

In chronic cases the analysis of the personality and subconscious factors is of more importance than merely noting the symptoms. After one has ruled out all organic physical disease, the procedure is along the lines of analytical psychology or psychoanalysis. In the chronic cases in war and in peace the outlook differs as to whether the constitutional make-up is normal, hysterical, inadequate paranoid, etc.

Some people still refer to hysteria in the way they do to malingering. But though a vicious and unfortunate way of reacting, it certainly does not belong in the same category as malingering. We are in full accord with the remark of Wiltshire when he says that poisoning by shell gas is only exceptionally a real cause of a neurosis.

In the chronic cases and in those cases occurring since the signing of the Armistice I have been impressed by the fact that the psychopathic taint as shown by emotionally unstable and inadequate traits has been much more in evidence. In such cases certain complexes were present, preventing recovery. So we naturally feel that the diagnosis of hysteria or neurasthenia applied to a case still ill, and which developed early in the war, hardly shows the real picture. The complaints of such patients toward the end are often trivial

compared to their early symptoms. Needless to say, most of them do not feel able to resume their work in the world. It is natural that one wants to know why. They now resemble the ordinary chronic neuroses of civil life, with various psychic conflicts. Their present symptoms are often only rationalizations for their behavior and failure to get well.

The desire to avoid pain or to gain pleasure is always present even if subconscious. In these chronic cases the question to decide is to what extent the mechanism is subconscious, and needless to say to get at the complexes and to try to make an adjustment.

In many cases one is really dealing with a personality anomaly only. It is safe to say that an ordinary neurosis would not persist for seven or eight months, except for some deep-seated complexes and often a constitutional psychopathic taint. In many such cases the hysteria or fatigue neurosis was merely engrafted on the psychopathic state, so that at the end one still has a defective constitutional make-up to deal with.

TREATMENT. There are a few interesting points in reference to the treatment of the neuroses of war time to which we might call attention.

When in England I noticed that the Babinski idea of curing hysteria by persuasion was followed almost exclusively, and the method was very successful in removing the immediate symptoms. But little attempt was made to get the patients to understand the mechanism of the neurosis; however, one reason being lack of time, the other being that but few men in England have paid much attention to the study of psychoanalysis, for the subject aroused a stormy controversy in Great Britain as to its merits and otherwise.

Sir John Collie, one of the old-school neurologists, said he did not think psychoanalysis necessary. Mott said: "I do not find it necessary or even desirable." Needless to say neither of them are students of the subject. Forsythe favored it, as did Rows, Adrian and Yealand. Eder, too, must have approved of it, for he said that suggestion, especially under hypnosis, and aimed rather at the complexes than at the symptoms, was good; but to get at the complexes, he must have used psychoanalysis. Proctor used suggestion under hypnosis. Myers and Buzzard regarded hypnotism favorably.

As there has been so much doubt expressed as to the need and value of psychoanalysis, I think it would be well to say a few words about the employment of it in the neuroses of war. One realizes, of course, that in a majority of the cases a cure can be effected in much shorter ways. But psychoanalytical training helps one to understand and to treat the cases better, especially the chronic ones.

I know of no better way of presenting the psychoanalytic viewpoint than to quote some of the views on the subject as presented by Ernest Jones, probably the most eminent psychopathologist of

Great Britain. He has published a very interesting article on this question in vol. xi of the *Proceedings of the Royal Society of Medicine*, April 9, 1918.

Heredity is vague in explaining complex psychological phenomena. Suggestion merely introduces another problem.

Some factor other than stress and strain must be present to produce these conditions, for less than 1 per cent. of the soldiers developed neuroses. We all know that psychoneuroses result from unconscious mental conflicts. One can only gain access to the unconscious by some sort of psychological investigation. The etiological factors in these cases are often more complex than is usually supposed, and they are particularly individualistic. War causes an official abrogation of normal standards. The adjustment to war is very difficult for some men to make. Besides heredity and social customs, certain ideas of the early relation of the child to its parents have to be taken into consideration. In the development of his ego man comes to approve of certain standards and to disapprove of certain others. His ego-ideal is not always easily a victor, nor always fully successful.

The mind deflects his anti-ego impulses from a forbidden goal on to an ethically proper one; or their energy is repressed and a barrier is erected—so-called “defence-reaction.” In this way one who is naturally cruel may become oversensitive to painful situations, etc. But as the large majority of men were able to adjust themselves to the field of war—not a conscious adjustment only, of course—they thus permitted the inhibition of the ego-ideals against the infliction of cruelties, etc. But Jones says that in all neuroses it is important to study the relation between a current conflict and a biologically older one, the current one arousing buried and only imperfectly controlled older conflicts.

Neuroses are not, as the French psychopathologists claim, any diseases that may happen to a person, but they are unconsciously produced in the patient’s mind for a definite purpose, *i. e.*, they are volitional, but not by the conscious will, nor are they deliberately purposeful. There is at the bottom of the mechanism an unconscious desire to obtain a pleasure by gratifying some repressed impulse which is out of harmony with the ego-ideal. The motive is to achieve some current end by the development of a neurosis.

The neurotic symptoms are the result of the psychic conflict; the incapacity—as a paralysis, for example—fulfils the desire, against which desire the patient has been fighting (a wish fulfilment).

But the important feature is not merely that the wish is unconscious, there being different degrees of consciousness or awareness, but that the repressed wish is against the ego-ideal and is the cause of the unawareness. Jones does not believe that a present repressed wish alone can cause a neurosis (if it could there would have been many more neuroses in this war, I believe, too). It can do so only

by reviving older repressed conflicts. Where there is a failure of adjustment we notice an introversion or a turning inward of the patient's feeling (affect). The present wish becomes associated with repressed wishes of older conflicts. Such a combination characterizes neurotic disorders; they thus differ from other ways of reacting to difficulties.

There are three factors entering into a neurosis: heredity, and "infantile fixation" during evolution, and the present or current conflict. They are all related, so that if one factor is pronounced another may need be slight to produce the neurosis. Thus with a very bad heredity an ordinary daily experience may precipitate the attack. In the neuroses of war the present conflict is of the greatest importance.

In these patients one frequently notices traits characteristic of childhood: sensitiveness to slights, being too self-centered and a desire to be helped. In the war cases the infantile repressed factor has not been sought for, yet it is very important in the chronic cases, which are hardly war neuroses any longer, but resemble peace neuroses entirely.

The reason for the greatest opposition to the psychanalytic theory is the statement that the older infantile repressed wish is a sexual one.

In the cases we are discussing the conflict has to do with the instinct of self-preservation and the preservation of the species. But a neurosis is a disorder of the unconscious imagination. So if we say the war were the only cause, that would be equivalent to saying that the neurosis resulted from a conflict of the ego-ideal and the instinct of self-preservation, which denies the former theory.

Psychoneurotic symptoms may be developed to prevent the exhibition of fear. Fear, with causeless dread and apprehension, various phobias and bodily manifestations, is really morbid anxiety. One sees it in impending danger and evil, as in anxiety neurosis and hysteria; its characteristic feature is the disproportion between its intensity and justification. It is claimed that it stands in close relation to unsatisfied and repressed sexual libido, the morbid anxiety representing the discharge of the energy. This is a defensive reaction of the ego against the claims of the unsatisfied sexual hunger; a projection outward in the form of phobias; it is the ego's fear of the unconscious. Normal fear reacts sensibly and properly to external danger, and not like anxious dread and terror, which paralyzes choice and action. The neurotic is frightened without any external danger.

Another theory of dread—morbid anxiety—is that it is derived from the repressed sexual hunger that is directed toward external objects, but from the narcissistic part of the sexual hunger attached to the ego. Thus it is important to distinguish object libido, *i. e.*, sexual impulses directed outward; and ego libido, *i. e.*, the narciss-

sistic portion directed inward, constituting self-love. This latter is the more primary, more extensive and the less studied of the two. It may be compared to a well from which externally directed sexuality is but an overflow. I can confirm Jones's opinion that little attention has been paid to this phase of the subject by psychopathologists in studying war cases.

An excess of sexual hunger may cause suffering. There results first a discharge in the form of morbid anxiety. A perfectly normal man is free from morbid dread at all times. This war has proved that. The intolerance of narcissistic sexual hunger, with dread in the face of danger, results in an accumulated tension.

Many of the symptoms of the neuroses of war corroborate this view of wounded self-love, as lack of sociability, lack of affection for relatives and friends, the feeling that their personality has been wounded or neglected and their importance not recognized, etc. So too in such patients their unconscious idea of death is a reduction of essential vital activity, or else a state of calm, in which the ego survives, but is freed from the disturbances of the outer world.

It will be very interesting to investigate our cases with these views in mind. It was my good fortune to meet Jones in London recently, and the views of England's most eminent psychopathologist furnish food for reflection.

All will agree that psychanalysis takes time. In the large hospitals devoted especially to this class of cases, where we admitted hundreds of patients per month, we could not go into the psychological mechanism in all the cases. One observation which I would like to make, however, is the relatively large number of married neurotic soldiers who gave a history of severe marital upsets, as unhappiness, separation, divorce.

I think we will all agree that hypnotism alone is bad on psychological grounds, as it does not remove the causes. The same applies to suggestion but not to psychanalysis.

Mott disclaimed hypnosis, claiming that it was undesirable. Mott, however, being a neuropathologist, his opinion in these matters does not carry the weight that it would were he speaking of organic conditions. We might add here also that neither suggestion nor hypnosis alters the state of the patient's mind.

In treating these patients one should lighten their burdens and protect them from unsympathetic surroundings, but should not foster their symptoms by misplaced sympathy. In many of the emotional patients I secured good results in the acute stage of their illness by complete isolation. First rule out any organic or metabolic disorder; then the treatment is individualistic and essentially psychological. Rest is the best aid in the acute stages, both mental and physical rest. In order for them to secure mental rest, however, their conflicts must be brought to light and an adjustment made.

Later in the course of the disorder, too much rest or lounging, and

a failure to provide productive occupations help to keep up the symptoms. I have seen hysterical paraplegics who had been bed-ridden in surgical wards for a couple of months, chop down trees a few days after coming to the neuropsychiatric wards. The will to work is very important. It is self-evident that the loss of the work habit is disastrous. The wish to be cured is essential. A careful and systematic examination makes an impression on these patients; it therefore has therapeutic value. The patient must be made to realize his obligations. Any asocial tendencies, as well as hypochondriacal trends, must be combated. Do not allow the patient to develop an attitude of chronic invalidism. Treat the patient and his disordered personality: they are of greater importance than the symptoms.

The reëducation of the patient must not be confined to a mere restoration of his lost physical function, but must also include the correction of any defects of feeling, will or intellect.

Electricity and massage are used almost entirely for their suggestive influence. Any concomitant physical disorder must be treated according to the dictates of rational medicine.

A very important point to remember is that one's self-assurance of success has greater effect on the patient than any direct reasoning one may employ. This is nothing new, but physicians often disregard this dictum, and we see neurotic patients frequently going to various frauds and quacks who succeed just because they apply this point with emphasis. The hypersuggestible patients have full faith in the assurances.

The neuroses of war have taught us but little that is new. But because of their frequency and the widespread interest that has been taken in them they will probably stimulate physicians in the future to take a greater interest in the neuroses of civil life.

LOCALIZATION OF TUMOR METASTASES.

BY G. E. ARMSTRONG, C.M.G., M.D., LL.D. (Queens),
D.Sc. (Liverpool),

CHIEF SURGEON, ROYAL VICTORIA HOSPITAL,

AND

H. OERTEL, M.D.,

PATHOLOGIST, ROYAL VICTORIA HOSPITAL, MONTREAL, CANADA.

THE term metastasis as applied to tumors is generally held to mean generalization of a growth by formation of secondary deposits throughout various tissues and organs of the body and not directly connected with each other. But this is really not an all-embracing

definition, for the conception of metastasis requires not only deposit, but subsequent growth of the misplaced tumor cells, with replacement of the physiological tissue by the tumor. Thus all kinds of cells, including bacteria, may become dislodged from their original focus and be arrested in different situations, but we can only speak of a metastasis when this new location is involved by disease; for the passive lodgment of foreign cells may be, and frequently is, followed by their destruction or quiescence. The appearance of foreign cells in an organ or tissue is therefore significant and practically important as a step toward metastasis, but in itself is not proof of it.

This important point has not received adequate consideration in recent experimental work on the artificial production of cancer. The fact that, on artificial stimulation by lipoid solvents and other irritants, proliferation of cells has occurred and that some of these newly formed cells have been disconnected and have reached neighboring tissues and even lymph glands by means of the lymph stream, is no proof of their metastasizing quality or even true tumor character. This proof is furnished only then when it can be demonstrated that these cells are not only carried by a stream and arrested in a tissue, but possess the ability of growth and organization to a tumor and the power of replacement of the physiological tissue.

The same strict interpretation of metastasis must be applied to spontaneous tumors. If, for example, we find on microscopic examination tumor cells arrested in the capillaries of the lung which they have reached by a massive break of a growth into the venous system, we are not really justified to speak of a metastasis in the lung, although that is often enough done. In infections the evidence of the disease is the anatomical lesion. Just so, in tumor metastasis the evidence is growth of tumor tissue into and annihilation of physiological tissue by it.

Emphasis is put on this point not only because of the previously stated erroneous interpretation placed on the appearance of arrested, disconnected cells in experimental cancer production in animals, but because an investigation into the problems of tumor metastases is rendered impossible by lumping the occurrence of tumor emboli with actual growth of tumor cells; for the problem of tumor metastases is not to be found in the transport and arrest of cells but in their growth to a tumor tissue. Upon this depends the unique encroachment and replacement of physiological tissue, which are the genuine attributes of metastasis.

One other point is not sufficiently appreciated, especially by clinicians, and needs explanation at the start. It is generally assumed that the histological picture is an almost absolute expression of the biological character of a growth; in other words, that malignancy and formation of metastases go hand-in-hand with the

immaturity of tumor components, that tumors of embryonic undifferentiated parenchyma are malignant and metastasizing and tumors of mature cells and arrangement benign and local.

A more profound consideration of this statement will show that this idea is untenable and cannot be upheld as a general law of tumor growth; for we know a number of tumors of embryonic tissue which do not, or at least very rarely, generalize. These are the sarcogliomata; congenital melanomata (nevi); spindle-cell sarcomata or endotheliomata of the dura mater; the epulis; many sarcomata and cancers of the ovary, of the uterus and of the mediastinum; sarcomata of the fascia; the teratomata and the embryonic growths or remains of the gut and the appendix. These tumor types may exist for years, are often an accidental finding, and do not, except in rare instances, exhibit any tendency to infiltrate and metastasize, although they may locally recur after excision.

On the other hand the reverse is also true, for anatomically mature so-called benign tumors will occasionally lead to secondary growths. This now well-established fact has been observed in fibromata, myxomata, lipomata, gliomata of the retina, angiomata, enchondromata, myomata and typical thyroid tumors.

This interesting and practically important fact was already well known to Virchow, but especially emphasized in the brilliant discussion of tumor growth by Cohnheim in his lectures on general pathology. So much were Virchow and Cohnheim impressed by these observations that the former believed that malignant properties in a tumor were subsequent to an innocent period, and Cohnheim, going further, advanced the view that malignancy and power of metastasis were in no way dependent upon the nature of the growth. To the contrary it was his opinion that infiltration and metastases depended upon the condition of the surrounding tissue. Cohnheim, following the reasoning of Thiersch on the primary development of cancer, attributed the occurrence of metastases to a removal of the physiological resistance in the invaded tissue. He attempted to support this idea experimentally by artificial introduction of periosteal flaps into the pulmonary circulation through the jugular vein. He and Maas observed in such cases the formation of thrombi of periosteal tissue. Within two weeks occurred growth of periosteal cells in these vessels to cartilage and bone. Then, however, they regressed, did not invade the neighboring tissue and finally succumbed. The conclusions which Cohnheim drew from these and similar observations of Goldtzieher and Schweningen were that regression occurred because the foreign cells were unable to resist the metabolism of the physiological tissue. Consequently, Cohnheim applied these ideas to the problem of metastases: "Only when and where tissues are lowered in their physiological metabolism by age, atrophy and inflammation will metastases be possible."

A study of tumor metastases carried on in a series of ninety-eight

successive cases of metastasizing tumors of various kinds and derivation in the laboratories of the Royal Victoria Hospital and of McGill University has revealed that in the localization of metastases two determining factors exist, viz., quantity and quality of tumor cells. It appears that in these respects tumor cells may be compared to invading parasites. In one as in the other instance the manner of invasion as well as the quantity introduced are naturally of great importance. It may be compared to the well-known difference of tuberculous infection, in which much depends upon how and how many tubercle bacilli invade an organism. When ordinarily a relatively small number are introduced and moved along by the lymph stream, they are anchored by certain tissues more readily than by others, and it is well known that the lungs, quite apart from mechanical considerations, are most susceptible to the insults of this microörganism.

On the other hand, when tubercle bacilli are poured in large quantities directly into the blood stream or even lymph stream such an elective action and localization do not occur and disseminated miliary tuberculosis develops in practically all organs of the body.

The first instance illustrates qualitative selection, the second simply quantitative overwhelming of the body by the infecting agent.

Similar conditions are found to prevail in the manner and method of some tumor metastases. In a case of small prostatic cancer, so small that only microscopic examination revealed it, practically all organs of the body were the seat of small, nodular, multiple metastases, closely resembling miliary tubercles, and clinically the case had been diagnosed as miliary tuberculosis. Careful microscopic examination of this prostate showed an unusual rupture of small tumor cells into small veins of the prostate, and from these the generalization had probably occurred.

A similar generalization is more frequently seen in the so-called hypernephromata or renal cancers. Here our laboratory records show a not infrequent massive rupture of softened tumor masses into the renal vein and extension *en masse* to the right heart and lung. In one case of a male, aged fifty-four years, a tumor thrombus extended from the right renal vein through the vena cava and the right auricle into the right ventricle and, apparently following the blood current, into the pulmonary artery. The smallest branches of this artery showed tumor emboli and, simulating miliary tuberculosis, small tumor growths in the parenchyma around them. Similar tumor plugs were found in the iliac veins and metastases in the liver and spleen.

These and other cases illustrate that even cancers may travel by the blood stream and that this path of dissemination, together with a large quantity of tumor cells thus introduced, dictates the distribution of the metastases.

Turning now to the frequent metastases in the regionary glands in close proximity with a tumor, several factors must be considered.

In the first place it is practically important that not all enlarged glands in the neighborhood of tumors are the seat of metastases. They are frequently simply inflammatory enlargements. It may be said that this is the rule in the enlargement of the pelvic glands in cancer of the uterus and in the lymph glands of the neck in cancer of the tongue, and is even frequently seen in the portal glands and mesenteric glands in cancer of the stomach and the gut. Sometimes these glands remain inflammatory throughout the course of the tumor growth; in other cases, however, they become sooner or later the seat of metastases. In a case of an extensive squamous-cell cancer at the base of the right side of the tongue, recently observed, the submaxillary lymph glands on both sides were distinctly enlarged and firm. On the left side they proved to be, on microscopic examination, only inflammatory; on the right side several of them showed small, early metastases taking origin from the lymph sinuses.

The relationship of the inflammatory changes to the tumor metastases is instructive and suggestive. It is not impossible that at least in a number of these cases, in which infection by bacteria can be reasonably excluded the constant drain of metabolic tumor products is irritating to the gland tissue, and thus, by lasting injury and upset of physiological tissue balance by inflammatory changes, predisposes the organ to metastatic growth. If this is the case it would appear to have an important bearing on the formation of metastases; for it would indicate that, under certain conditions at least, the occurrence of metastases is made possible or favored by a drain of metabolic tumor products into a tissue.

Cohnheim's theory may therefore be correct in emphasizing lack of resistance on the part of the physiological tissue and inability to dispose of these foreign cells. This weakening of the physiological tissue may, moreover, be due to the direct action of specific tumor products. This theory would naturally apply best to the explanation of those metastases which are nearest and most intimately connected with the original growth and in which a more or less constant and concentrated communication exists. Late metastases might be explained by gradual weakening of physiological resistance.

But when we come to distant, often isolated metastases and consider the frequency with which some organs are involved in certain types of tumors irrespective of their primary location it is evident that other factors must enter into their formation.

Mechanical arrest of tumor plugs through anatomical peculiarities can hardly be of paramount importance in such cases, for everyone knows how rarely the spleen is the seat of a secondary tumor. By virtue of its anatomical structure as a true filter it offers the best

mechanical arrangement for detention of tumor cells. There must, therefore, exist other reasons.

Virchow drew attention to the fact that those organs which are rarely the seat of primary tumors are the most chosen seat for secondary deposits. This, however, can hardly be generalized, and Virchow, himself, gave no explanation of the matter.

In order to arrive at a knowledge of the frequency with which certain tissues are selected in metastases an analysis of the ninety-eight cases studied in this laboratory during the last few years was made. The malignant tumors were first classified according to their ordinary histological appearance. Then their embryogenetic origin was determined, that is, from which layer of the blastoderm the growth originated. The location of the metastases was then analyzed according to the occurrence of metastases in ectodermal, mesodermal and entodermal tissue. The glands were analyzed by themselves.

Type of tumor.		Ectoderm.	Location of metastases.		Glands.
			Mesoderm.	Entoderm.	
Epitheliomata,	11	0	2	2	8
Adenocarcinomata,	29	2	16	20	16
Carcinomata,	36	5	13	30	20
Sarcomata,	7	0	6	8	10
Endotheliomata,	6	0	3	6	8
Teratomata	1	0	2	1	0

CHART I

Type of tumor.	Origin of tumor.	Ectoderm.	Location of metastases.		Glands.
			Mesoderm.	Entoderm.	
Epitheliomata	3 Ectoderm	0	1	0	2
	8 Entoderm	0	1	2	6
Adenocarcinomata	2 Ectoderm	0	5	4	3
	5 Mesoderm	1	3	2	1
	22 Entoderm	1	8	14	12
Carcinomata	3 Ectoderm	4	4	5	1
	4 Mesoderm	0	2	2	2
	29 Entoderm	1	7	23	17
Sarcomata	1 Ectoderm	0	1	0	1
	5 Mesoderm	0	5	8	9
Endotheliomata	1 Entoderm	0	0	0	0
	6 Mesothel	0	3	6	8
Teratomata	1	0	2	1	0

CHART II

It is, of course, impossible to draw from such a table definite conclusions regarding the selective property of metastases, for other factors but selective action, some of which have previously been mentioned, complicate the value of such charts. Nevertheless, some points are interesting and more or less suggestive. Thus it will be seen that of 22 adenocarcinomata which took their origin from entoderm, 14 metastases formed in entoderm, and of 29 carcinomata which were derived from entoderm, 23 formed metastases in entoderm. Furthermore, of 5 sarcomata, 5 metastases occurred in mesodermal tissue. It is true that in these sarcomata there were

also 8 metastases in entoderm organs—the liver, the lungs and the pancreas—but the metastases in these instances were apparently not selective but due to causes previously discussed. It is also not unlikely that selection is greater in growths derived from more highly differentiated entodermal glandular tissue.

Although the material analyzed is relatively small a suggestion is contained in it that embryogenetic and biological relationship of tumor tissue to physiological tissues may influence the often strange selective metastases. In other words it would appear as if close embryogenetic affinity of tumor cells to tissues of the same derivation influence metastatic selection. It is well known that lymphosarcomata metastasize with preference in lymphadenoid or mesodermal tissues.

The conclusion is therefore reached that the localization of metastases depends upon a number of factors. Important among these are:

1. The quantity of the tumor elements and the method of dissemination.

2. Effects of injurious metabolic products of tumor cells upon a tissue, causing degeneration and inflammation and thereby weakening its physiological resistance.

3. Close biogenetic (embryonic) relation of tumor cells to a tissue soil, whereby types of tumor cells derived from an embryonic layer grow more readily in the environment of organs or tissues which are derived from the same layer of the blastoderm.

Accurate determination of this last point will only be possible with a large amount of tumor material analyzed grossly and microscopically with full regard to the factors discussed above.

ISOLATION OF THE MENINGOCOCCUS FROM CASES OF SO-CALLED INFLUENZA.

By MAJOR ROGER KINNICUTT, M.C., U.S.A.,

AND

FIRST LIEUT. CARL A. L. BINGER, M.C., U.S.A.

INTRODUCTION. Material for the following bacteriological study was obtained from cases occurring in two epidemics of so-called influenza and from a number of scattered cases admitted to the U. S. Base Hospital No. 6, Bordeaux, France. The first epidemic spread among a forestry organization stationed in and about Mimizan in the Department of Landes. In the three camps affected,

approximately 350 cases appeared in a strength of 553; about 30 of these were complicated by bronchopneumonia and 15 died. The condition encountered presented an almost constant symptomatology with a few minor variations; headache and generally bodily pains of rather sudden onset, elevation of temperature lasting from three to ten days, relatively slow pulse-rate, considerable prostration and signs of a diffuse bronchitis. Nose-bleed was a common feature. In the fatal cases there was delirium, deep cyanosis and evidence of extensive bronchopneumonia consolidation.

Cases in the second epidemic investigated presented a similar clinical picture. At this time the disease was still apparently in its "pure" form, not confounded by the great variety of respiratory infections encountered among troops in France during the fall and winter months. Diagnosis was therefore relatively simple and the selection of cases suitable for study presented no special difficulties. This epidemic occurred during September and the first fortnight of October, 1918, at Camp Hunt, Le Courneau, in the Department of Gironde. The epidemic seemed to be divided into two separate outbreaks, probably originally from different sources. The first began about August 10; there were about 800 cases, 28 pneumonia and 7 deaths. The second was imported to the Artillery Camp by the arrival of 3500 troops from Brest. In the two outbreaks 3915 cases developed requiring hospitalization, with 275 pneumonia and 65 deaths.

The scattered cases studied at Base Hospital No. 6 came from a variety of casual organizations stationed in the Base Section and from soldiers evacuated from the Zone of the Advance. These were more difficult of diagnosis and selection. The disease had lost, to a certain extent, its type, and confusion, with early lobar pneumonia, bronchitis and coryza, was hard to avoid. This may perhaps, to some extent, explain the divergent findings in this group of cases.

Technic Followed in Bacteriological Investigations. For blood cultures the best medium was found to be ascitic agar or coagulated blood media slants in flat-sided Pasteur tubes, the tubes being about one-quarter filled with dextrose infusion broth (0.4 per cent. acid).

For all other cultures a coagulated sheeps' blood medium was used, the formula for which is: Defibrinated sheeps' blood, 2 or 3 parts; dextrose infusion broth (0.2 per cent. to phenolphthalein), 1 part. The mixture is well shaken, slanted, inspissated and sterilized by fractional sterilization in an Arnold sterilizer. This medium is chocolate-colored, furnishing an excellent background for examining colonies, and partially differentiates the various micrococci. Upon it the meningococcus grows well, as rather large, round, gray, shiny, flat colonies, with smooth edges. Pneumococci and many of the streptococcus group grow as brilliant green colonies, with green discoloration of the medium. Other streptococci show a marked whitish ring around the colonies. The common hemolytic streptococcus produces no color change.

Cultures were obtained from the nasopharynx, sputum and blood of patients with influenza alone and with bronchopneumonia complicating the disease. At autopsies of cases dying of bronchopneumonia cultures were made from the hearts' blood and pneumonic areas in the lungs. (Numbers given indicate cultures from individual cases.)

The sera used for agglutination reactions with Gram-negative diplococci isolated in this investigation were Types A, B and C meningococcus serum (French classification) obtained from the Pasteur Institute and in a few cases a polyvalent Rockefeller Institute antimeningococcus serum. Each of the test sera was used in dilutions of 1 to 25 and 1 to 50. A normal horse serum control, dilution 1 to 25, was always used in each test. The bacterial suspensions were made in normal salt solution from pure cultures of Gram-negative diplococci grown on coagulated sheeps' blood medium. All agglutination reactions were macroscopic and carried out in a water-bath at 37° C.

MIMIZAN EPIDEMIC. Ten blood cultures were taken in dextrose broth. All but one showed no growth. One, taken two hours before death, gave a pure culture of meningococcus Type C. At the autopsy of this case meningococcus was not recovered from the heart's blood or lungs.

From the lungs of 4 cases out of 10 dying of bronchopneumonia meningococci were recovered at autopsy. From one case meningococci were recovered from an acute suppurative otitis media. All strains recovered agglutinated with the Rockefeller polyvalent antimeningococcus serum and not with normal horse serum. Only two of these strains isolated were typed; one was Type C and the other Type B. (All strains isolated in this epidemic except the one obtained from blood were lost.)

Protocols. No. 78, R. L. H., Sgt. 1Cl., Co. "E," 4th Btn., 20th Engrs.

Clinical Diagnosis. Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia of all lobes of both lungs.

Lung Cultures. Meningococci, Type C, recovered from the left upper and the left lower lobes.

No. 79, G. A. B., Co. "E," 4th Btn., 20th Engrs.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs.

Lung Cultures. Meningococci, Type B, recovered from the right lung.

No. 80, C. C. C., Pvt., Co. "E," 4th Btn., 20th Engrs.

Influenza; bronchopneumonia. Blood culture in dextrose broth taken two hours before death, Type C, meningococci, in pure culture.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs.

Lung Cultures. Meningococci not recovered.

No. 81, H. N., Pvt., Co. "F," 4th Btn., 20th Engrs.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs. Acute suppurative otitis media (right).

Lung Cultures. Meningococci not recovered. Culture from right middle ear. Gram-negative diplococci, agglutinated by Rockefeller Institute polyvalent antimeningococcus serum and not by normal horse serum. (Not typed, culture lost.)

A. W. W., Pvt., Co. "F," 4th Btn., 20th Engrs.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs.

Lung Cultures. Gram-negative diplococci, agglutinated by Rockefeller Institute antimeningococcus serum and not by normal horse serum, recovered from right lower lobe. (Not typed, culture lost.)

C. H., Pvt., Co. "E," 4th Btn., 20th Engrs.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia, involving all lobes of both lungs.

Lung Cultures. Gram-negative diplococci, agglutinated by Rockefeller Institute polyvalent antimeningococcus serum and not by normal horse serum; recovered from right upper lobe. (Not typed, culture lost.)

LE COURNEAU EPIDEMIC. *Nasopharyngeal Cultures.* Twenty-five cultures were taken. Of these 22 showed Gram-negative diplococci. From 14 of these 22 cultures Gram-negative diplococci were isolated in pure culture; 9 of these 14 strains were agglutinated by Rockefeller Institute polyvalent antimeningococcus serum and not by normal horse serum; 5 strains were not agglutinated by either serum. The type of only two of these positive strains was determined. Both were agglutinated by Type C serum and not by Types A, B or normal horse serum.

Sputum. Specimens from only 4 cases were cultured. All showed Gram-negative diplococci, and from 2 these micrococci were isolated in pure culture, both of which were agglutinated by Type C, serum and not by Types A, B or normal horse serum. In 1 case at the onset of the infection, Type C meningococcus was isolated from the nasopharynx, and at the beginning of convalescence from the sputum. This patient had influenza, with no complicating pneumonia.

Blood Cultures. The first 25 blood cultures were taken in broth and were all negative for Gram-negative diplococci. The last 15 blood cultures were taken in Pasteur tubes containing solid, slanted media as well as broth. Two or three times a day the mixture of blood and broth was shaken and run up over the solid medium slants. This was done because the meningococcus is essentially an

aërobe. Of these 15 cultures 4 showed Gram-negative diplococci. Of these 4 strains 3 agglutinated with Type C serum, not with Types A, B or normal horse serum, the fourth, as yet, will not agglutinate with any of the sera on hand. No blood cultures positive for Gram-negative micrococci were obtained except in fatal cases complicated by bronchopneumonia.

Heart's Blood. Of 24 cultures taken, 4 showed Gram-negative diplococci. Agglutination reactions were done with 3 of these strains; 1 was not agglutinated by any of the sera used, 2 agglutinated with a Type C serum, not with Types A, B or normal horse serum.

Lungs. Twenty-two cultures were taken; 12 showed Gram-negative diplococci, 5 in almost pure culture. Of these 12 strains 11 agglutinated with Type C sera, not with Types A, B or normal horse serum, and 1 did not agglutinate with any serum used.

Protocols. No. 13, R. E. B., Pvt., 5th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 27, 1918. Blood culture in dextrose broth; no growth.

September 30. Blood culture in Pasteur tube; Gram-negative diplococci in pure culture (culture lost.)

No. 14, H. E. L., Pvt., 5th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 20, 1918. Blood culture in dextrose broth; no growth.

September 22. Died.

Autopsy. Bronchopneumonia involving the whole of the right lung except the apex; left lower and part of the left upper lobes. Marked edema of the brain.

Cultures. Heart's blood: Streptococci and Type C meningococci.

Lungs: Streptococci and Type C meningococci.

No. 18, H. S., Pvt., 5th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 20, 1918. Blood culture in dextrose broth negative for meningococci.

September 22. Died.

Autopsy. Bronchopneumonia involving the right, upper, middle and left lower lobes.

Cultures. Lungs: Gram-negative diplococci recovered from the lower lobe of the left lung.

No. 21, H. B., 5th Bty, F. A. R. R.

Influenza. Blood culture in dextrose broth; negative for meningococci.

September 22, 1918. Died.

Autopsy. Beginning empyëma (left.) Extensive bronchopneumonia involving all lobes of both lungs.

Cultures. Lungs: Gram-negative diplococci, not agglutinated by any antimeningococcus serum on hand, isolated from right lower and the left upper lobes.

No. 36, H. F., Cpl. Hqs. Co., F. A. R. R.

Influenza. September 21, 1918. September 25. Died.

Autopsy. Bronchopneumonia involving the right upper, middle and the lower lobes and the left lower lobe.

Cultures. Lungs: Type C meningococci.

No. 39, A. C. B., Pvt., 4th Bty., F. A. R. R.

Influenza. September 23.

September 30. Bronchopneumonia.

Blood culture in Pasteur tubes. Type C meningococci in pure culture.

October 2. Died. Cultures not obtained at autopsy.

No. 54, E. M., Sgt., 2d Bty., F. A. R. R.

Influenza; bronchopneumonia.

September, 1918. Died.

Autopsy. Extensive bronchopneumonia involving all the lobes of both lungs.

Lung Culture. Type C meningococci recovered from the left upper lobe.

No. D. S., Pvt., 5th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 25, 1918. Died.

Autopsy. Extensive bronchopneumonia involving all the lobes of both lungs.

Cultures. Lungs: Type C meningococci recovered from the right lower and the left lower lobes.

No. 60, W. F. M., Pvt., 4th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 25, 1918. Died.

Autopsy. Beginning acute fibrinopurulent pericarditis. Empyema (left). Extensive bronchopneumonia, involving all lobes of both lungs.

Cultures. Lungs: Type C meningococci recovered from left upper lobe.

No. 73, F. W. G., Pvt., 2d Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 27, 1918. Died.

Autopsy. Empyema (left.) Gelatinous exudate over the right lung. Extensive bronchopneumonia involving all the lobes of both lungs.

Cultures. Lungs: Type C meningococci in almost pure culture recovered from the right lower, left lower and right upper lobes.

No. 78, W. H. G., Pvt., 2d Bty., F. A. R. R.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs.

Cultures. Lungs: Type C meningococci in almost pure culture recovered from the right lower and the left lower lobes.

No. 79, C. C. D., Pvt., 2d Bty., F. A. R. R.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all the lobes of both lungs.

Cultures. Lungs: Type C meningococci recovered from the left lower lobes.

No 80, E. A. G., Pvt., 6th Bty., F. A. R. R.

Influenza; bronchopneumonia.

Autopsy. Extensive bronchopneumonia involving all lobes of both lungs.

Cultures. Lungs: Type C meningococci in almost pure culture recovered from left upper and right middle lobes.

No. 81, L. F. T., Pvt., 1st Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 28, 1918. Blood cultures, Pasteur tube, Type C meningococci in pure culture.

September 29. Died.

Autopsy. Empyema (right). Extensive bronchopneumonia involving all lobes of the right lung and the lower lobe of the left lung.

Cultures. Heart's blood; Gram-negative diplococci recovered. Not agglutinated by serum on hand. Culture lost.

No. 85, J. M. B., Pvt., 5th Bty., F. A. R. R.

Influenza; bronchopneumonia.

September 28, 1918. Blood culture in Pasteur tube; Type C meningococci in pure culture.

September 30, 1918. Died.

Autopsy. Extensive bronchopneumonia involving all the lobes of both the lungs.

Cultures. Heart's blood and upper lobe of right lung; Type C meningococci recovered.

One case admitted as "influenza" after two days in hospital turned out to be epidemic cerebrosplinal meningitis.

No. 93, M. C., Pvt., F. A. R. R.

Influenza.

September 30, 1918. Sick about twelve hours. Temperature, 99° F. Blood culture in Pasteur tubes; Type A meningococci in pure culture.

October 2. Meningeal symptoms.

Lumbar Puncture. Cloudy fluid showing polynuclear leukocytes and a few Gram-negative diplococci.

Culture. Type A meningococci.

Diagnosis. Epidemic cerebrosplinal meningitis (Type A).

October 2. Blood culture in Pasteur tube; no growth.

Cases Studied in U. S. A. Base Hospital No. 6. The cases of influenza studied at U. S. A. Base Hospital No. 6 were from many camps and organizations, some directly from transports arriving

from the United States. At this time other respiratory infections, evidently not true influenza, began to appear among troops. Numerous blood cultures were taken in many different ways; in none were Gram-negative diplococci obtained.

In a series of fifteen autopsies on patients dying of bronchopneumonia following influenza, from the lungs of only three were meningococci isolated. These three strains isolated were all Type 9. One of these strains was obtained from a case taken from a transport arriving from the United States.

Protocols. No. 5, J. C., Cpl., 351 Supply Co., Q. M. C.

Influenza; bronchopneumonia. Off transport from United States. Influenza epidemic on board. Died.

Autopsy. Empyema (right). Acute fibrinous pericarditis. Extensive bronchopneumonia involving all the lobes of both lungs.

Cultures. Lungs: Type B meningococcus recovered.

No. 11, J. D., Pvt., 321, F. A.

Influenza; bronchopneumonia.

October 22, 1918. Died.

Autopsy. Extensive bronchopneumonia involving all the lobes of both lungs.

Cultures. Lungs: Type B meningococcus recovered.

No. 1, C. T., San. Dept., Det. 343, Infantry.

Influenza; bronchopneumonia.

October 20, 1918. Died.

Autopsy. Empyema (right). Acute purulent pericarditis. Extensive bronchopneumonia involving all lobes of both lungs.

Cultures. Lungs: Type B meningococcus recovered.

Other Types of Bacteria Encountered. In the LeCourneau epidemic eight blood Gram-negative cultures taken from patients with bronchopneumonia showed Gram-negative micrococci of the Streptococcus-pneumococcus group. In all, cultures taken from pneumonic lungs of the Streptococcus-pneumococcus group, in varying numbers, were found. Twelve out of twenty-four cultures taken from the heart's blood of cases dying of pneumonia also showed members of this group. No attempt was made to classify these Gram-positive micrococci; some were green producers, some hemolytic and a few, growing as large, mucoid, green colonies and showing a definite capsule in stained specimens, were probably either pneumococci Type 3 or Streptococcus mucosus. During the study of this epidemic three cases of epidemic cerebrospinal meningitis occurred in the camp hospital. The meningococci cultured from the spinal fluid of all these three cases were agglutinated by Type A serum, not by Type B, C or normal horse serum. From one of these cases a blood culture, positive for Type A meningococcus was obtained two days before the patient developed meningeal symptoms.

In a series of fifteen autopsies at Base Hospital No. 6, hemolytic streptococci, *Streptococcus viridans*, pneumococcus Type 3 and pneumococcus Type 4 were recovered from the heart's blood and lungs in the different cases. In two instances Pfeiffer's bacillus was recovered from the lungs.

During the epidemic of influenza there was a moderate number of scattered cases of epidemic cerebrospinal meningitis. Meningococci recovered from the spinal fluids of the majority of these cases were Types A and B; in only three instances were Type C meningococci recovered.

ADDENDUM. Since writing this report a small epidemic of "influenza" in "pure" form occurred in Company "G," Ammunition Train, stationed at St. Andre de Cubzac, an organization which had escaped the disease during the main epidemic. Forty cases occurred in this organization December 1 and 2. December 4, nasopharyngeal cultures were taken from 29 of these 40 cases. From 16, or 55 per cent., of the cultures taken, Gram-negative micrococci, morphologically and culturally, were isolated. All these microorganisms fermented dextrose and maltose and not saccharose. Fourteen of the sixteen strains isolated were agglutinated in dilutions of 1 to 50 and 1 to 100 at 52° C. for eighteen hours by polyvalent New York City Department of Health antimeningitis serum and not by normal horse serum in dilution of 1 to 25. Two strains could not be agglutinated by any antimeningococcus serum on hand. Of the agglutinable strains it was possible to type only two with the serum on hand. These two strains were Type B. Repeated attempts at typing the other strains were made, both at 37° C., with several different lots of sera, but with consistently negative results.

In connection with the Le Courneau epidemic a high percentage of patients in this later epidemic harboring meningococci in their throats is of interest, and by typing it was hoped possibly to throw more light on the etiology of the disease.

From the throats of three of these twenty-nine patients, Pfeiffer's bacillus was recovered.

DISCUSSION. From the above findings no definite conclusions can be drawn. The findings in the Le Courneau epidemic, taken alone, might suggest that Type C meningococcus bears an important etiological relation to the cases of disease from which it was obtained. However, study of cases in different localities where a similar or identical disease was prevalent does not bear this out, as Type B meningococcus was recovered at autopsy from the lungs of a certain number of those cases. On the other hand it can be stated that the meningococcus group of bacteria is associated in some way with certain cases of the so-called influenza which prevailed among the American Expeditionary Force in France.

The foregoing studies were made during the early autumn of

1918. It is therefore interesting to see that a somewhat similar study carried out at Southampton by Captain William Fletcher¹ yielded similar results. Captain Fletcher states that between September 25 and November 23, 1918, cultures were made after death from the lungs and heart's blood of 36 American soldiers who had died of postinfluenzal bronchopneumonia. The illness of these men arose a week or ten days before on transports crossing the Atlantic. In 11 of the 36 cases the lungs and in 3 instances the heart's blood yielded numerous colonies of Gram-negative cocci. Subcultures of these cocci from 7 cases were examined serologically. six were found to be Type II and 1 Type I meningococcus (Gordon's classification). The other four strains had been lost. In all the 11 cases, *Bacillus influenzae* was present in the lungs in association with the meningococcus. In 2 instances pneumococci, in 1 streptococci and in still another streptococci and pneumococci were found. A British soldier suffering from bronchitis at about the same time yielded from his frothy and purulent sputum a Type IV meningococcus.

Comparing the results obtained in France by us and in England by Fletcher the following may be stated: Nicolle's Type B meningococcus corresponds with Gordon's Type II while Nicolle's Type C has no counterpart among Gordon's types. Hence, using Gordon's classification, the type meningococci obtained from the heart's blood and lungs of cases of influenza occurring from late September to late November, especially in the American Expeditionary Force, have been chiefly Type II.

The postinfluenzal bronchopneumonias have shown a varied bacteriological flora on culture. This flora, moreover, conforms with the large number of pathogenic bacteria, the *Bacillus influenzae* possibly excepted, occurring in the upper respiratory tract. It is now known that meningococcus is a not infrequent inhabitant of the nasopharynx. Moreover, during the autumn epidemic meningitis was not infrequent among the American Expeditionary Force. Hence carriers of meningococci were also common. It is therefore probable that the occurrence of meningococci in the lungs and heart closely parallels the occurrence of streptococci and pneumococci, only that the latter are more infrequent. All are to be viewed as secondary invaders and concomitants and not primary microbic causes of influenza. But as meningococci are hardly regarded as being concerned in any manner with bronchopneumonia, it appears proper that the findings we have made should be recorded.

¹ Lancet, January 18, 1919, p. 104.

ACCOUNT OF AN EPIDEMIC OF INFLUENZA AMONG AMERICAN TROOPS IN ENGLAND.¹

BY F. M. MEADER, M.D., MAJOR, M.C., U.S.A.,

J. H. MEANS, M.D., MAJOR, M.C., U.S.A.,

AND

J. G. HOPKINS, M.D., CAPTAIN, M.C., U.S.A.

(From the Office of the Surgeon, Base Section 3, A. E. F.)

INTRODUCTION. The great autumn pandemic of influenza made its first appearance in England with the arrival at the port of Southampton of "Transport 56" from the United States. Following this, nearly every transport that arrived in England for the next four weeks brought large numbers of men either ill with the disease or who subsequently developed it. In addition a considerable number of cases broke out among American troops permanently stationed in England. Those who were most affected were the personnel of hospitals that had received patients.

Altogether, from September 20, 1918, when the above-mentioned transport arrived until the present writing, November 14, 1918, there have been approximately 7800 cases of influenza among American troops hospitalized in Great Britain. Of these, about 5000 have been cared for in American and the balance in British hospitals. Of this total number of cases 3350 developed at sea and occurred among a total of approximately 177,000 troops landed in that period. The morbidity and mortality from influenza among troops landing in England is shown in Table I.

TABLE I.—SHOWING CASES OF INFLUENZA AND DEATHS AT SEA THEREFROM AMONG AMERICAN TROOPS ARRIVING IN ENGLAND.

Week ending.	Cases of influenza landed per 1000.	Deaths at sea per 1000.
Sept. 26, 1918	15.8	0.03
Oct. 3, 1918	36.2	3.68
10, 1918	42.9	7.05
17, 1918	25.2	3.18
24, 1918	8.6	2.60
31, 1918	2.9	0.13
Nov. 7, 1918	6.5	0.00
14, 1918	1.0	0.06

¹ The authors of this paper have all been actively engaged in some phase of handling the influenza epidemic in England, and this paper represents in part a report of their own work. In addition, they have acted in an editorial capacity and consolidated the observations made in all the American hospitals. Their sincere thanks are due to the commanding officers and professional staffs of the several hospitals for their hearty coöperation. Further, an expression of appreciation is in order for the intelligent way that the cases have been handled and studied in all the American hospitals in England. It is hoped that further papers will appear, giving, in greater detail, the experience of various clinics.

In other words, of 177,000 troops landed in the period September 20 to November 14, 1918, 19 per thousand were ill with influenza on arrival and 394, or 2.2 per thousand, died *en route*. The above table also indicates that the importation of influenza had ceased at the present writing. In addition to the imported cases a certain number developed among a fixed American military population of about 28,000. Subtracting those that were ill on arrival from the total we have 4450 developing in England among a combined permanent and transient military population of 205,000. This makes the observed morbidity of influenza 10 per thousand per month for the period September 20 to November 14, 1918. The actual morbidity is undoubtedly higher, for cases probably developed in the transient troops during the period but after their departure from England. Of these latter cases the writers have no information. There was a total of 900 deaths in England during the period, or a mortality of 2 per thousand per month. Of the total cases of influenza, both on land and sea, 16.5 per cent. died during the period.

The influenzal process was frequently complicated by bronchopneumonia, and this complication, except in rare instances, was the cause of death. Of the total cases of influenza hospitalized, about 2300, or 29.5 per cent., developed pneumonia, and of these 900, or 39 per cent., died. When the cases dying at sea are included the percentage of pneumonia cases dying becomes 60 per cent. Assuming the average length of voyage to be about two weeks, it will be seen that the mortality at sea is about double that on land.

There has not been sufficient clerical force available to show the admission to hospitals of cases of influenza by weeks, but Chart I, which shows the total of cases of pneumonia hospitalized in England by weeks and the deaths therefrom, will give a good idea of the progress and severity of the epidemic. (See Chart I.)

CHART No. 1.—SHOWING NUMBER OF CASES OF PNEUMONIA AND DEATHS
THEREFROM, AMERICAN TROOPS, ENGLAND.
SEPTEMBER 1ST TO DECEMBER 1ST 1918.

DATE	NO CASES	NO DEATHS	NUMBER.											
			50	100	150	200	250	300	350	400	450	500	550	600
SEPT. 2	21	1												
9	16	2												
16	13	5												
23	26	9												
30	367	92												
OCT. 7	553	313												
14	427	141												
21	423	84												
28	363	97												
NOV 4	152	111												
11	223	48												
18	297	98												
25	168	146												
TOTAL	3049	1147												

SOLID LINES REPRESENT DEATHS
DOTTED " " CASES

CHART I

EPIDEMIOLOGY. It has not been possible to make detailed statistical studies of all the individual ship epidemics nor of the incidence among permanent personnel as a whole. Such studies, however, have been made in a few instances, and will, by way of illustration, give an excellent idea of the various aspects of the outbreak.

EPIDEMIC OF "TRANSPORT 56." This epidemic, which is one of the most severe of the group, has been studied in great detail, and since it can be followed from start to finish, forms an excellent illustration.

The transport left an American port on September 14 with 5951 troops on board. When two days from port a medical inspection of the entire personnel showed 7 cases of measles, 1 of which developed bronchopneumonia and died on September 21. During the voyage there developed 14 cases of mumps, 16 of measles, 4 of scarlet fever, 3 of pneumonia and a number of cases of acute respiratory tract infection (influenza). The latter rapidly assumed epidemic proportions, as will be seen in Chart II, which shows the daily incidence of such cases both during the voyage and among the troops after debarkation. (See Chart II.)

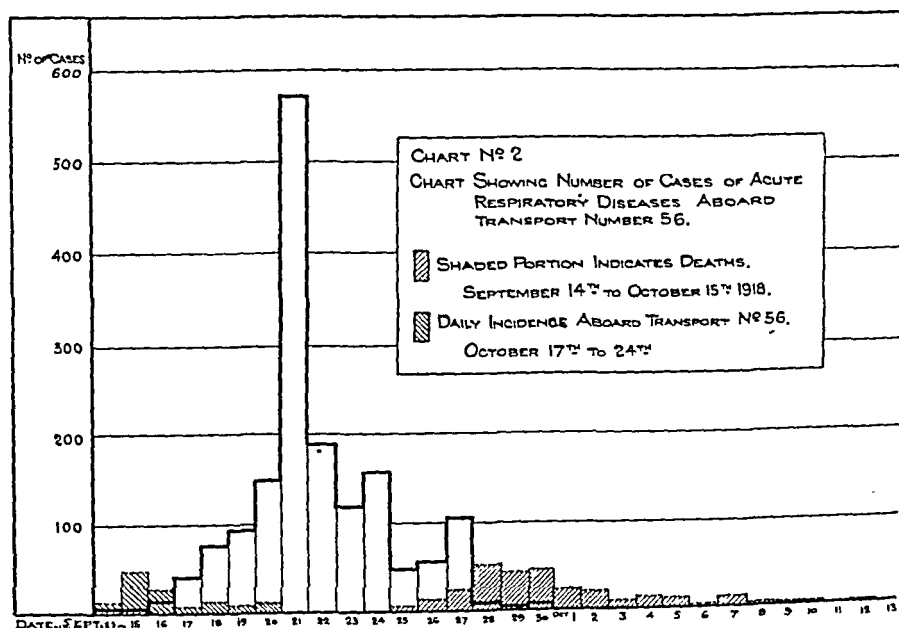


CHART II

The ship reached an English port on September 21, the high point of the epidemic, and it was probably the debarkation of troops that prevented the further spread of the disease.

The ship's sanitary report shows that early in the voyage sanitary conditions on board were satisfactory, but that on September 21, when the great incidence occurred, great difficulty was experienced

in properly caring for the patients, and the general sanitary condition became bad.

Owing to transportation difficulties it required several days to get all the sick off the vessel, and they were not all clear of her until September 25. The troops not ill were sent to an American rest camp in the vicinity. During the period from September 23 to September 27 many cases developed in this camp, which appear in Chart II, but by October 1 the epidemic had practically ceased. The conditions in the rest camp were better than on board ship, but even then there was much overcrowding, the camp containing 29 per cent. above its normal capacity. (See Chart III.)

CHART No 3 CHART SHOWING DISTRIBUTION OF ACUTE RESPIRATORY DISEASES AMONG PASSENGERS ABOARD TRANSPORT No 56. SEPT 14 th - OCT. 15 th 1918									
ORGAN	No IN ORGANIZATION	PER CENT ILL				% ILL BEFORE LEAVING BOAT		% ILL AFTER LEAVING BOAT	
		10	20	30	40	50			
332 M.G.	A 182	6.5					2.6	3.9	
	B "	4.4					1.1	3.3	
	C "	6.5					2.2	4.3	
	D "	7.2					3.4	3.8	
	HQ 25	8.0					0.0	8.0	
333 M.G.	A 183		15.8				7.65	7.75	
	B "		13.6				7.1	6.5	
	C "			10.1			9.8	8.3	
	D "	3.8					0.0	3.6	
	HQ 25				32.0		24.0	8.0	
343 INF	A 218				31.6		17.3	14.0	
	B "				25.7		16.9	8.8	
	C "				22.5		16.9	5.6	
	D "				31.6		21.1	11.5	
	I "					45.1	41.3	6.8	
	K "					36.2	26.1	10.1	
	L "					34.0	29.6	4.4	
	M "					32.5	29.7	2.8	
	SAN 35		12.0				7.6	4.4	
	MC 218		13.6				7.3	6.3	
S.A.R.D CAMP GORDON	15 240		15.7				4.2	11.5	
	16 "				34.2		19.5	14.7	
	17 "				35.4		25.8	9.6	
	18 "			27.5			9.2	18.3	
	19 "			25.4			12.9	12.5	
	20 "				38.3		19.2	19.1	
	21 "		10.2				6.7	3.5	
32 nd MET.	56		10.8				5.4	5.4	
Sig. CORPS	36					44.5	5.4	39.1	
NURSE A	101				30.7		6.9	23.8	
" D	100					38.0	5.0	33.0	
" BH.58	101					44.5	0.9	43.6	
PSY* I	5			20.0			—	20.0	

CHART III

In Chart III the incidence among the various organizations on board will be found. It will be noted that some units had a greater number become ill before leaving the ship, others after. The nurses in particular showed a much higher incidence on shore than before landing. This is easily explained by the fact that they were assigned to duty on the ship and in the various hospitals caring for the ill soldiers.

Chart IV was prepared in order to determine how many cases developed after arrival in hospital. It will be seen that 317 cases,

or 74.3 per cent., of the total had already developed before the cases were hospitalized. A few cases developed during the first and second days after admission, and in one hospital there was a considerable outbreak twelve to thirteen days later. (See Chart IV.)

CHART No. 4 DATE OF ONSET OF PNEUMONIA AFTER ADMISSION TO HOSPITAL																		
HOSPITAL	NO. CASES	NO. PNEU.	NO. PNEU. ON ADMISSION	DAY ON WHICH PNEUMONIA DEVELOPED AFTER ADMISSION														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
U.S. BASE 33	474	134	118	11	4	1												
RED CROSS 21	389	141	135		1	1	1											
U.S. BASE 204	271	109	45	4	1		5	1	1	1	2	1	3	17	16		1	1
U.S. BASE 40	124	13	7	1			1		1	1	1				1			
U.S. BASE 37	162	47	19	5	6	5	6		1	4						3		
U.S. BASE 29	60	23	14	2	2	2					2	1						
SHIRLEY (BRITISH)	84	22	20	2														
UNIVERSITY WAR (BRITISH)	44	39	39															
CAMP 35	60	6	—	2			1	2		1								

CHART IV

In one hospital, which was located 180 miles from the port of debarkation, 96 per cent. of the cases admitted already had pneumonia on arrival, while in another hospital, distant only eight miles, only 41.5 per cent. had pneumonia on arrival.

The uniformly high death-rate of the pneumonia is shown in Chart V, which gives the percentage dying in each hospital. It may be said that in the two British hospitals listed therein, where the mortality was very high, the cases were practically moribund on admission, and at C.H. 35 there were post-measles pneumonia. In general, however, the severity of the disease seemed to bear some direct relation to the distance the patients were transported. (See Chart V.)

In order to gain some idea about the general condition of the troops, information was obtained of the size of their home towns. This data is shown in Chart VI. It appears that two-thirds of the patients came from towns having a population under 6000. As to the State from which they came it was found that about one-quarter were from Wisconsin and a considerable proportion were from Minnesota and Illinois. A study of their pre-war occupations disclosed the fact that about 58 per cent. were from farms. (See Chart VI.)

It is interesting to note the length of time that these patients had been in the service. In Chart VII it will be seen that 41 per cent. began their military training in July, 23 per cent. in June and 10

per cent. in May, 1918. They were therefore for the most part not hardened to the conditions of warfare, and hence were particularly susceptible to a virulent infection. (See Chart VII.)

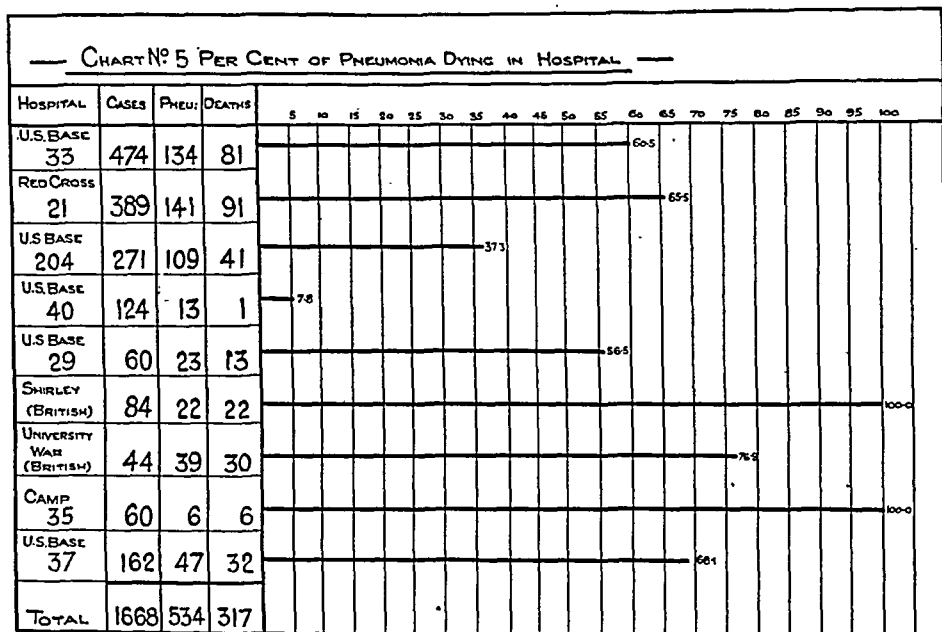


CHART V

CHART. No 6 PER CENT OF CASES OF ACUTE RESPIRATORY DISEASES FROM COMMUNITIES
OF VARIOUS SIZES.

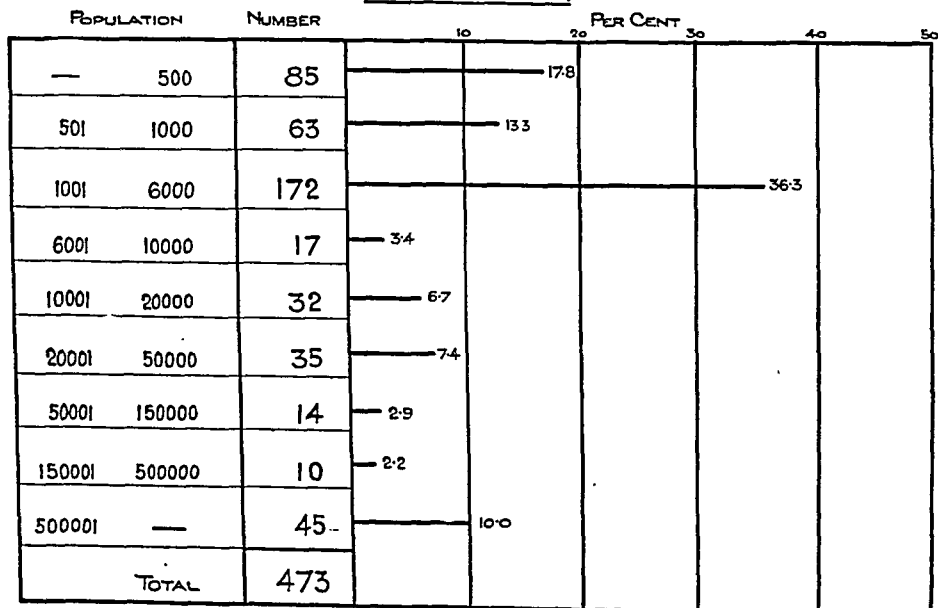


CHART VI

Information was asked from many concerning the details of their journey. Considerable evidence of debilitating conditions was

obtained. For instance, practically all complained that the shower bath which they had once or twice during the voyage was a severe ordeal. They said they were obliged to remain undressed, without covering, for a considerable period and then passed through a shower of sea-water. Many of them dated their colds from these baths. They also complained that the food issued in the ration was unpalatable and that they ate but little of it. Instead, they bought such articles of food as crackers, sardines and candy at the Canteen and ate at irregular intervals. Altogether, their method of obtaining food was sufficient to derange their digestive systems and probably did not give sufficient nourishment. Most of the men who became

— CHART N° 7 LENGTH OF MILITARY SERVICE. —

MONTH	Nº		10	PERCENT	30	40
MAY 1917	2	0.1				
JUNE "	—					
JULY "	—					
AUG. "	—					
SEPT. "	9	1.6				
OCT. "	1	0.09				
NOV. "	—					
DEC. "	—					
JAN. 1918	7	1.0				
FEB. "	26	5.0				
MAR. "	28	5.1				
APR. "	23	4.0				
MAY "	59	10.4				
JUNE "	120			23.6		
JULY "	225					41.05
AUG. "	41	7.04				
SEPT. "	9	1.03				
TOTAL	548					

CHART VII

ill had to sleep in hammocks. They complained that the lights were on all night and that the air in their quarters was foul, so that they were unable to sleep. It is evident that the nervous tension, which was quite unavoidable, owing to the circumstances of the voyage, made it impossible for the men to receive proper rest during the trip.

Inquiries were made relative to the illnesses which patients had had during the previous six months. These disclosed the fact that only about 126 had been ill. The illnesses complained of in order of their frequency were measles, gastric disturbances, rheumatism, malaria, mumps, pneumonia and influenza. The number giving a past history of pneumonia within six months was eight and of influenza seven.

To sum up, "Transport 56" arrived at a British port with 5951 troops. It left the United States on September 14 and arrived on September 21. On the day of arrival 574 cases of influenza developed. By October 15, 1668 cases had developed, which is about 28 per cent. of the total number of troops. Of those who thus became ill, 534, or 32 per cent., were complicated by pneumonia, and of these 317, or 19 per cent., died. Of those who developed pneumonia, 59.3 per cent. died. These figures are strikingly like those previously given for the entire epidemic in England.

The morbidity and mortality by weeks for this epidemic are shown in Table II.

TABLE II.—INCIDENCE AND DEATH.

Rate per 1000 per month from influenza. Transport 56. First epidemic.

Week ending	Morbidity.	Mortality.
September 20	264	...
September 27	836	30
October 4	16	140
October 11 . . . . .	...	17

In marked contrast to this experience is the next voyage of the same transport. She again left the United States on October 17 and arrived in England on October 24, with scarcely more than a normal amount of sick, although a mild epidemic had been in progress during the trip. The incidence of influenza on the second trip is also indicated in Chart II.

The following extracts from the report of the transport surgeon are of extreme interest:

"Troops were all examined and their temperatures taken before the ship sailed and over 167 cases of influenza removed to shore.

"A general daily examination was made of all the troops and an evening temperature taken of the units by a medical officer.

"All on board were treated as contacts. Gauze masks were worn by all troops and the nose and throat sprayed with iodine and albolene solution, 1 gr. to 1 oz., twice daily. The last spraying was done before bedtime.

"The first day out of port, from 4 P.M., October 17 to October 18, 7 A.M., 11 new cases were reported. Second day to October 19, 7 A.M., 47; third day to October 20, 7 A.M., 17; fourth day to October 21, 7 A.M., 8; fifth day to October 22, 7 A.M., 14; sixth day to October 23, 7 A.M., 9; seventh day to October 24, 7 A.M., 11. These cases include 11 not of influenzal origin.

"Fifteen cases of pneumonia developed.

"Conclusion. These precautions seem to control an undoubted epidemic."

This epidemic of 117 cases among 5430 troops, with 15 cases of pneumonia and no deaths at sea, showed an incidence of 86 per 1000 per month, and 13 per cent. of the total cases of influenza developed pneumonia. It is further noteworthy that no increase in the epidemic occurred after debarkation.

From the second voyage of "Transport 56" it might be concluded that the measures taken—namely, masking of all souls on board, spraying daily and segregation of those with fever—prevented a widespread epidemic. This conclusion is not justified, however, because it happened that at about the same time another transport, the "Anchises," from the same port of embarkation, and loaded with troops from the same camp in the United States arrived at a British port with no cases of influenza, despite the fact that the only precautions taken were daily observation of the temperatures and segregation of those with fever. Further examination disclosed the fact that the troops on both these ships had passed through an epidemic before sailing and were therefore made up of those who had resisted this infection.

EPIDEMIC OF "CONVOY 46." The first trip of "Transport 56" shows what happened on a fast ship. The following brief account of what occurred on a slower vessel is also worthy of note: Steamship "Nestor" left New York on September 17 with 2807 troops on board. No illness appeared until two days out, at which time several cases of influenza appeared in one hold. The ship put in at Sydney, N. S., on September 20, and Colonel Spitska, the S. M. O., insisted that all sick, together with contacts, be landed. This was done and somewhat over 600 men were put ashore.

The ship then proceeded on her voyage, and *en route* somewhere in the vicinity of 60 per cent. of all those on board developed influenza. Many of these had recovered by the time she reached port on October 2. There were 21 deaths at sea, or 9.5 per thousand, about 19 per thousand per month. The incidence of influenza was somewhere in the neighborhood of 1200 per thousand per month. The sanitary conditions on board the transport were bad. She was overcrowded and the ventilation was poor.

These two ship epidemics present the two extremes found. In one instance a fast ship with the epidemic breaking out toward the end of the voyage and checked by debarkation, in the other a slow ship with an epidemic raging for two weeks and on the decline when she reached port. Other ships presented similar or intermediate pictures. The epidemic in this case suggests what a very serious state of affairs might have occurred in "Transport 56" had not the troops been promptly debarked.

EPIDEMIC AT BASE HOSPITAL 29. As an example of how fixed personnel occasionally became involved a brief statement of an epidemic occurring among the personnel of Base Hospital 29 may be of interest. This hospital received a convoy of 60 cases of influenza

from "Transport 56" on September 24. Table III shows the incidence of influenza and the death-rate among the hospital personnel following the receipt of the convoy.

TABLE III.—SHOWING INCIDENCE INFLUENZA AND DEATH-RATE PER 1000 PER MONTH. PERSONNEL OF BASE HOSPITAL 29.

Week ending	Morbidity.	Mortality.
September 28	80	0
October 4	180	0
11	220	0
18	500	48
25	180	36
November 2	100	12

Other hospital personnels were affected, but not as seriously. The high incidence in Base Hospital 29 can be explained very likely by the fact that it is situated in a crowded portion of London where influenza was quite prevalent among the local population. Also, perhaps, partly because this organization, having fairly recently come from a high dry climate in the States, may have been less acclimatized to the damp weather prevalent in England than were other organizations.

CLINICAL FEATURES OF DISEASE. To get an accurate description of the clinical features of the disease under discussion an attempt has been made to collect and consolidate the observations of the medical officers in charge of the cases in all of the American hospitals in England. From the reports received and from the observations of officers visiting the several hospitals in turn it becomes apparent that we are dealing with a definite clinical entity, presenting essentially similar features in cases derived from different sources and localities.

The patients were largely received from incoming transports from America, though a certain number developed among the medical and nursing personnel and patients in hospitals for other conditions, apparently as a result of direct contact. The state of advancement of the disease varied somewhat among the groups received from various ships. Thus in the case of the rapid "Transport 56," the epidemic had only assumed alarming proportions on the day of arrival in port, so that many cases developed, and practically all the deaths occurred on shore.

With the slower ships, such as the "Nestor," taking from fourteen to fifteen days, on the other hand, the epidemic had often apparently involved the greater portion of the susceptible persons on board, and many of the patients received by the hospitals after the ship's arrival were in the most serious stages of the disease.

Histories were not always obtainable, but in general the stories told and the onset observed in the cases that developed under observation present a similar picture.

ONSET. The onset is, as a rule, sudden, with fever, chilly sensations or rigors and oftentimes a marked degree of prostration. Aching in the extremities and back and chest were often complained of, and headaches occurred in a considerable proportion. Muscle tenderness was frequent. Previously to this sudden onset many of the patients had been quite well. This applies particularly to the cases that developed in England, but in many of those that developed on board ship there were histories of common colds, sea sickness and exhaustion for several days previously. Coughing, with a mucopurulent sputum, occurred from the start in practically all of the cases. In addition a certain number showed a definite coryza, with sneezing, not, however, with conjunctivitis as in measles. Sore-throat was occasionally present, but was not a common feature. Hoarseness may occur in the later stages, but not usually in the beginning.² The sputum even on the first day or two of the disease was occasionally streaked with fresh blood, and epistaxis was often seen. The pulse in such early cases was usually full and bounding, of good tension and the rate varying with the temperature from 80° to 120°.

UNCOMPLICATED INFLUENZA. All cases having started as outlined above, developed further in one of two definite ways: They either ran an uneventful course of from three to seven days, ending in recovery, or they developed a most serious type of bronchopneumonia. The former group, which we may call simple influenza, comprised from 60 to 70 per cent. of the whole. Of the course of these uncomplicated cases there is nothing of any great moment to

²In regard to laryngeal involvement the following report, by Captain William M. Banc, of Base Hospital No. 29, is of interest:

"Among the 235 cases of influenza and the 54 cases of pneumonia which have been cared for in this hospital from September 1, 1918, to October 25, 1918, there have occurred 9 cases of laryngitis, 6 of which developed only hoarseness and cough and 3 a complete aphonia.

"The type observed has been invariably an acute catarrhal aryngitis. The active cause is infection by invading organisms which gain entrance into the mucosa when its resistance has been lowered by one or more of the following: Irritating cough, toxins evolved from diseased nasal mucosa, accessory sinuses or pharynx; inspiration of air improperly moistened, warmed and filtered by reason of nasal obstruction. The influenzas and pneumonias almost all show inflamed and swollen mucous membranes in the nose and throat, and mouth breathing is commonly observed. Sinusitis, especially frontal, has been very common.

"Of the subjective symptoms, alterations in voice and the cough have been constant, but pain has been very uncommon. Objectively, very slight swelling and hyperemia of the cords and adjacent mucosa have been observed, but no cases in which there was any edema, hemorrhagic areas or ulcerations have been seen.

"As to prognosis it seems that the infection, although quite virulent, has attacked the upper respiratory tract much less severely than the lower part, so that the outcome from the laryngitis is usually good.

"Treatment has consisted essentially of limitation in the use of the voice, complete rest where possible and mild inhalations of tincture benzoin comp. and steam every three hours. The inhalations were not only beneficial to the mucosa of the throat but usually very soothing to the patient with severe bronchitis. Appropriate treatment to the nose, accessory sinuses and tonsils is essential. The cases with complete aphonia regained the use of the voice in about three days, followed by a prolonged period of hoarseness. Another case with aphonia proved to be hysterical."

relate. The fever continued generally from one to seven days, but usually from two to four days, and then fell either by crisis or rapid lysis to normal. With the fall in temperature the toxic symptoms cleared, if they had not previously, and oftentimes the patients would feel entirely recovered. In many cases a considerable degree of prostration persisted for several days. The cough usually persisted for a week or more and the patients continued to raise a small amount of purulent sputum after they were, in other respects, quite well. During the fever there was nearly always a considerable degree of anorexia and often profuse sweating. Abnormal signs in the chest in the cases of simple influenza were often entirely lacking, or in a certain number there might be a few scattered rales and ronchi. The patients were usually flushed and occasionally slightly dusky in appearance. The eyelids often were slightly puffy. Sometimes transient erythemas were noted over the trunk or extremities, but there was no characteristic exanthem or enanthem. To sum up: the picture was that of an acute infection of the upper respiratory tract, with very sudden onset and marked toxemia, and because of its epidemic form, evidently highly contagious.

INFLUENZA PNEUMONIA. We come now to the second type of the disease, which in reality seems to constitute what might be termed a superimposed epidemic and which took the form of an exceedingly fatal type of bronchopneumonia closely associated with a purulent bronchitis, and which is responsible for practically all the deaths occurring in the epidemic. This bronchopneumonia, though most probably caused by a different infectious agent from the original disease, bears a close relationship to the latter, inasmuch as it presents some very characteristic features which differentiate it from ordinary pneumonia, and because, so far as we can learn, it never appears out of a clear sky in a healthy individual but only in persons already suffering from influenza.

The pneumonia may begin anywhere in the course of the simple influenza, sometimes as early as the second day. It is ushered in by an apparent increase in the toxicity of the patient, by an increase in the rate of respiration and the early development of cyanosis. The physical signs of consolidation appear usually at one or both bases, though occasionally consolidation has first been noted in one of the upper lobes. At the same time there is generally found an increase in the amount of moisture in the chest, as shown by the presence of numerous moist rales scattered throughout. The sputum becomes more purulent and contains considerable quantities of fresh blood. Epistaxis also was exceedingly frequent. The course may be exceedingly fulminating, death occurring as early as the second or third day. In such cases the signs of consolidation rapidly extend, one lobe being involved after another in an almost explosive fashion, so that death may occur from mechanical asphyxia so great is the lung involvement. Other cases run a more prolonged course.

Patients may continue with the disease for two weeks and ultimately succumb. In such the consolidation is liable not to be particularly extensive, but the purulent bronchitis is a more prominent feature and the cause of death apparently is toxemia. Between these two types all grades of intermediate varieties were found. The temperature curve in the fulminating cases was apt to be continued high anywhere from 102° to 105° , the pulse varying from 100 to 130. Shortly before death the temperature would rapidly drop and the pulse rapidly rise. In the more chronic cases the temperature was liable to be very irregular, a septic temperature in fact. The cases that recovered usually showed a gradual lysis, though the crisis was occasionally observed. A pseudocrisis, followed by a resumption of fever of the irregular type, was more frequent. The respiration was nearly always increased in rate, and often shortly before death exceedingly rapid, sometimes as high as sixty per minute. It was apparently a tachypnea rather than a true dyspnea, however, for except in the moribund cases it was usually not a source of discomfort to the patient. Certain very striking differences between the influenza pneumonia and ordinary lobar pneumonia have impressed themselves upon practically all the officers who have had patients in their charge. In the first place the general appearance of the patient is unlike the usual pneumonia. In spite of his rapid breathing there is a striking absence of orthopnea; in fact, he usually lies flat by preference. There is almost never any pleural pain, and although an occasional friction rub has been heard it is exceptional. The painful grunting breathing of lobar pneumonia is almost invariably absent. The tenacious, tawny or rusty sputum of true pneumonia is not seen, but instead an abundant mucopurulent sputum, with considerable fresh, bright red blood is the rule. Another characteristic feature is the early developing and profound cyanosis seen in all the severer cases. It is of a peculiar tint, a deep lavender or heliotrope. As a rule the intensity of this cyanosis bears no definite relationship to the degree of consolidation. It may be as deep in the primarily purulent bronchitis cases in which there is little consolidation as in the fulminating cases with extensive consolidation. Moreover, no cause for it can be discovered in the circulation. No dilatation of the right heart can be made out on physical examination, and this is in part borne out by the autopsy findings; nor is the pulse necessarily of poor quality nor the blood-pressure low. A recent paper by Hoover³ is extremely interesting in this connection, and his views on the importance of foam in the bronchial tree may explain the non-relationship of cyanosis and degree of consolidation seen in these cases. As Hoover points out the presence of foam in the bronchial tree will cause a marked

³ Moisture in the Air Spaces of the Lungs and Oxygen Therapy, Jour. Am. Med. Assn., September 14, 1918, lxxi, 880.

hindrance to gas exchange in the lungs, and as most of these cases of influenza pneumonia have considerable moisture in the chest, their cyanosis may well be explained on that basis.

It should also be emphasized that epistaxis is frequent and highly characteristic of the disease.

Certain other noteworthy manifestations and complications have been observed. A moderate number of cases presented the signs of meningismus, and these were relieved by lumbar puncture, the fluid being sterile, but under pressure. Another striking occurrence was the development, in a few cases, nearly every hospital had one or two, of a subcutaneous emphysema of the neck and upper chest. This was unquestionably of mechanical origin, for it was never accompanied by any inflammatory process. It was as though air had been introduced beneath the skin and was unaccompanied by any redness or induration. The cause of this phenomenon has not been definitely established, but in one case that came to autopsy the emphysema was found to extend downward along the course of the trachea through the mediastinum and about the pericardium. Moreover, several cases at autopsy which had not presented emphysema of the neck during life showed emphysema in the mediastinum and about the pericardium, and one showed blebs of air over the visceral pleura. It seemed most likely that the air escaped into the lung, and following the course of the large bronchi made its way through the lung root and along the course of the trachea to the neck. In no instance was this condition associated with pneumothorax, nor was any case found at autopsy in which there might have been an escape of air from the lung through adhesions to the mediastinum. Rupture of the trachea or main bronchi was not found.

An occurrence which may or may not be accidental was the development in some of the cases, which had either had or were having influenza pneumonia, of meningococcus meningitis. This occurred in at least 30 cases, 20 of them being in one hospital. This uneven distribution suggests that the incidence of cerebrospinal fever was not causally related to the influenza, except in so far as the influenza might have been predisposing. Three cases of pneumococcus meningitis were reported.

Evidence of disease of the accessory sinuses of the nose was frequently found, as was also purulent otitis media. It is interesting to note in this connection that out of 26 autopsies in which the head was explored, empyema of one or more of the accessory sinuses was found in 21.

One case of undoubted acute endocarditis was found clinically and two at autopsy. Systolic murmurs at the apex were not infrequent, and in the cases that recovered, rapidly disappeared. Pericardial friction rubs have not been reported.

Abdominal complications beyond the distention often seen in pneumonia were lacking. Enlargement of the spleen demonstrable

on physical examination was rare. A few cases presented nausea and vomiting and acute abdominal pain.

Jaundice occurred in a small percentage of the cases.

An exceedingly interesting complication was observed at American Red Cross Hospital 4. Fifteen cases presented swollen, painful feet, and several of these showed acute red inflammatory areas over the toes and instep from 1 to 2 cm. in diameter. Two cases also showed blebs and bullæ over the shins. It was thought that there might have been septic thrombosis or embolism, the red areas being similar to those described by Osler in malignant endocarditis.

A negative feature of the epidemic, which is rather striking, is the comparatively low incidence of empyema.

CLINICAL PATHOLOGY. *Sputum.* The gross appearance of the sputum has already been described. The points to be emphasized in the pneumonia cases are its abundance and its striking difference from ordinary pneumonic sputum, in that in place of a tenacious rusty sputum there is found a yellow purulent sputum with abundant streaks of fresh blood.

Films of the sputum show usually a varied flora. Influenza-like bacilli were frequently found but so, too, were a variety of other organisms, having, for example, the morphology of pneumococcus or streptococcus.

Blood. Blood counts were not done systematically, but when done were of considerable interest. In the simple influenza the white count was usually low, 5000 cells per cm. being not uncommon. The pneumonia cases also often showed a leukopenia, sometimes a slight leukocytosis, rarely over 12,000 to 14,000, and practically never over 20,000. The fatal cases usually showed a leukopenia. This is in very striking contrast to ordinary pneumonia.

Urine. The urine showed the ordinary type of febrile urine, a moderate amount of albumin and tube casts being present particularly in the pneumonia cases. Blood was rarely seen.

TREATMENT. The preventive measures taken were entirely along the lines of isolation and hygiene, and are dealt with under the heading Hospitalization.

No specific therapy was employed except in one instance, and since the causative organisms were not definitely known, no specific therapy could be used except in an entirely empirical way. At the beginning of the outbreak it was thought that the pneumonia was very likely due to the streptococcus, and therefore a sensitized streptococcus vaccine obtained through the kindness of Lieut.-Col. Harvey, R.A.M.C., from the vaccine laboratory, was tried in a small series of cases, without, however, any apparent benefit to the patient.

Oxygen has been used fairly extensively without any very striking results. The patients might or might not improve temporarily, but the course of the disease does not usually seem to be materially altered. At one hospital the Haldane field apparatus for oxygen

administration was used. It was found to be a convenient way of giving oxygen, but beyond that no extraordinary beneficial effect was noted.

Further than this the usual symptomatic treatment of pneumonia has been carried out. Digitalis in some form has been commonly employed as well as camphor and other stimulants, and morphin or opium where indicated. At some of the hospitals urotropin has been used as routine.

Fluids have been forced by mouth, rectally and subpectorally.

It is felt that the hope lies in prophylaxis. Should the etiological factor be proved it should be possible to immunize against this disease. The immunity thus secured plus better methods of sanitation, particularly on board transports, should prevent a recurrence of the epidemic.

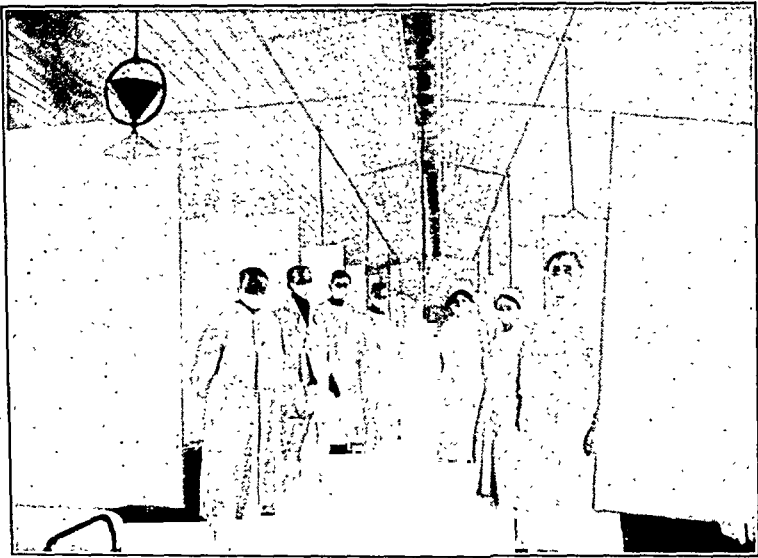


FIG. 1.—Showing methods of isolation ward in Base Hospital 29, Tottenham, England

HOSPITALIZATION. The matter of proper hospitalization of this sudden influx of contagious cases presented certain difficulties, but in general it was accomplished with all possible promptness, and except for the fact that in certain instances patients had to be transported for comparatively long distances on ambulance trains to reach hospitals, which is unquestionably undesirable, it is not thought that any cases suffered for want of proper hospital care.

In hospital, strict isolation was carried out from the start. Not only were the influenza cases and pneumonia cases segregated in separate wards, but in all the American hospitals they were screened one from another. The most usual method of screening was by means of sheets hung from wires. Fig. 1 shows this method in practice in a ward at Base Hospital 29.

Since the pneumonia may be due to a number of different infecting organisms, we believe that the importance of the prevention of cross infection by droplet infection by the use of screens cannot be too strongly emphasized.

In addition to these measures all personnel while on duty in the wards constantly wore gauze masks over the mouth and nose and were obliged to douche their nasal and oral cavities with some mild antiseptic solution once daily.

PATHOLOGICAL ANATOMY.⁴ A summary of the anatomical diagnoses recorded are shown in Table IV. Pneumonia was found in 99 per cent. of the fatal cases, and in 80 per cent. was apparently bronchial in distribution. The most common complication was fibrinous pleurisy, 39 per cent. Pleural effusions and empyemas were not uncommon, but were much less frequent than in the epidemics of streptococcus pneumonia occurring in the United States last winter. (See Table IV.)

Dilatation of the right heart was noted very frequently by some observers, less frequently by others. The difference in percentages noted may be due to individual differences in interpretation of the findings. A moderate enlargement of the spleen was noted in about half the cases and cloudy swelling of the liver and kidneys were recorded somewhat less frequently than one would expect in acute infections of this type. One finding which was rather common was chronic passive congestion of the liver.

Among the rarer lesions not noted in the table were peritonitis, which occurred in a few instances apparently as an extension from the pleurisy, and meningitis due to the influenza bacillus in two instances, to the streptococcus in one, to a mixture of these two organisms in one and in two instances to the pneumococcus. In cases in which the brain was examined it was common to find the pia distended with fluid and the cortex intensely injected. One might include under the complications the cases of meningococcus meningitis which followed bronchopneumonia, as both these meningitides and the pneumonias were probably sequelæ to the original grip infection.

⁴ The observations on the pathology and bacteriology of this epidemic are compiled from data and material contributed by workers at the various laboratories in this base section:

Major W. W. Williams, Base Hospital No. 29.
Captain A. W. Stahl, Base Hospital No. 204.
Captain G. A. Sorgatz, Camp Hospital No. 40.
Captain M. B. Beecroft, Base Hospital No. 37.
Lieut. R. S. Stauffer, Base Laboratory.
Lieut. R. R. Simmons, Base Hospital No. 33.
Lieut. F. B. Harrington, Camp Hospital No. 35.
Lieut. T. M. Marks, Base Hospital No. 40.
Lieut. D. C. Lee, A. R. C. M. Hospital No. 4.
Lieut. E. D. McBride, A. R. C. M. No. 21.

TABLE IV.—SUMMARY OF AUTOPSIES.

	B. H. No. 204.	B. H. No. 40.	B. H. No. 37.	Base Lab. (B. H. No. 35).	C. H. No. 40.	A. R. C. No. 4.	B. H. No. 29.	A. R. C. No. 21.	B. H. No. 33.	Total.	Per cent.
Total autopsies	53	2	25	25	21	127	19	21	101	394	
Lungs:											
Bronchitis	32	2	17	0	0	30	7	21	101	210	53.3
Bronchopneumonia	52	2	17	21	19	126	19	6	52	314	79.7
Lobar pneumonia	1	0	7	4	2	0	0	12	49	75	19.0
Abscess of lung	0	0	2	2	1	10	0	0	5	20	5.1
Gangrene of lung	0	0	0	0	0	0	0	0	0	0	0
Infarcts of lung	0	0	0	2	0	0	1	0	0	3	0.8
Pleura:											
Fibrinous pleurisy	16	0	13	19	11	59	4	2	29	153	38.9
{ Slight	12	0	1	10	1	10	4	5	24	67	17.07
{ Moderate	15	1	2	1	5	8	3	2	4	41	10.4
Pleural effusion ser.	10	0	2	0	6	4	4	1	3	30	7.6
{ Marked	1	0	0	0	0	3	0	0	6	10	2.5
{ Slight	5	0	0	1	4	6	1	1	5	23	5.8
Pleural effusion pur.	1	1	2	4	0	5	1	0	3	17	4.3
{ Moderate	23	1	12	15	11	13	5	6	24	110	27.9
{ Marked	0	0	0	0	0	5	0	0	0	5	1.27
Pleural adhesion											
Pneumothorax											
Pericardium:											
Fibrinous pericarditis	2	0	1	3	3	5	2	0	3	19	1.81
Serous pericarditis	40	2	1	10	14	17	9	7	8	108	27.4
Purulent pericarditis	1	0	0	3	1	3	0	0	0	8	2.0
Heart:											
Dilatation, right side	3	1	17	11	8	53	7	8	0	108	27.4
Dilatation, left side	0	0	0	1	8	0	1	2	0	12	3.0
Myocarditis, acute	0	0	0	0	0	0	0	0	0	0	0
Endocarditis, acute	1	1	0	0	0	0	0	0	1	3	0.8
Liver:											
Perihepatitis, acute	0	0	0	0	3	1	1	0	0	5	1.3
Parenchymal changes	1	0	12	8	2	88	2	0	2	115	29.2
Spleen:											
Perisplenitis, acute	0	0	0	0	9	1	0	0	0	10	2.5
Enlarged soft spleen	15	2	15	12	8	95	3	4	18	172	43.6
Other parenchymal changes	0	0	0	1	0	0	0	0	0	1	0.25
Kidneys:											
Simple congestion	18	2	9	2	10	38	2	8	0	89	22.6
Cloudy swelling	6	0	4	19	5	42	0	0	2	78	19.8
Actual acute nephritis	0	0	2	7	5	35	0	0	0	49	12.4
Accessory nasal sinuses:											
Number of examinations	17	0	0	9	0	6	0	0	0	32	15.6
Catarrhal sinusitis	0	0	0	0	0	5	0	0	0	5	69.0
Purulent	16	0	0	5	0	1	0	0	0	22	

NASAL SINUSITIS. A lesion which interested us considerably was a purulent inflammation of the sphenoid or ethmoid sinuses. This seldom gave pronounced clinical symptoms, but was found in 69 per cent. of the cases in which the sinuses were examined post-mortem—at one hospital in 16 out of 17 cases. It was striking from the bacteriological side that the same organisms as were found in these infected sinuses, were usually present in the consolidated lung of the same case. This fact suggested that these sinuses might be the primary focus of infection, a possibility which was also suggested by Major H. E. Robertson⁵ in connection with an earlier influenza epidemic.

PERIBRONCHIAL PNEUMONIA. The most important lesion apparently was the pneumonia, and this varied remarkably from case to case, both anatomically and bacteriologically. In the earlier cases the lung showed fairly uniform consolidation, approximating a typical lobar pneumonia, and differing from it chiefly in the hemorrhagic appearance of the lung and the moistness of the consolidated areas. From some of these massive pneumonias only the influenza bacillus was recovered on culture. In the later cases the consolidation was remarkably patchy, and toward the end of the epidemic cases began to appear which showed macroscopically a purulent bronchitis and practically no pneumonia. These last cases resembled strikingly those seen in an epidemic in France in December, 1917, which were uncomplicated influenza bacillus infections. Of the bronchopneumonias many showed minute abscesses, some showed extensive hemorrhages, many pronounced edema of the unconsolidated areas and in those with pleural effusions the picture was complicated by a compression atelectasis. These pneumonias were anatomically not one disease but a variety of terminal processes grafted on some original infection.

It is impossible, therefore, to describe any lesion typical of all cases. However, the majority of the lungs examined had certain common characteristics. They were, as a rule, very voluminous and contained considerable air, but firm nodules could be felt in the cushiony lung substance. Toward the posterior portion of the upper lobe and the base of the lower lobe these discrete masses were replaced by a solid block of airless lung. On section the consolidated areas stood out rather sharply, and frequently were in the form of a pyramid, with the base against the pleural surface of the lung. Scattered through them were dots and lines of opaque yellowish-gray material, frequently with points of black anthracotic pigment in the center, varying from 0.5 mm. to 3 or 4 mm. in thickness. In some cases these gray areas were firm and in others could be squeezed out as drops of thick pus. Between these foci the con-

⁵ *Jour. Am. Med. Assn.*, May 25, 1918.

solidated tissue was granular, rather moist, sometimes gray, but more frequently a brilliant crimson. Again, between these completely consolidated masses the lung tissue was often nearly solid, moist and red, apparently representing what Baehr has described as an explosive terminal extension of the pneumonia.

The arterial trunks were free, the larger bronchi and trachea intensely inflamed with bright crimson mucosa and a small amount of purulent or fibrinous exudate.

Microscopically the most interesting changes were in the smaller bronchi. These were frequently represented by a collection of leukocytes bordered on one side by the mucosa and muscular wall of the bronchus and on the other side emerging indefinitely with alveoli filled with purulent exudate. In other cases only shreds of bronchial epithelium could be made out, remaining here and there along the wall, and in many sections no remnants of the bronchial wall could be made out, the bronchi being apparently represented by little pools of pus, each lying close to an artery and a vein and bordered only by inflamed alveoli. The air cells immediately around these disintegrated bronchi were usually filled with pus, but beyond these was a zone in which the exudate was, as a rule, croupous, containing considerable fibrin, with red cells, leukocytes and epithelia in varying proportions. Not infrequently there were extensive areas of hemorrhage, in some of which the red cells lay within well-preserved alveoli and in others the lung framework had been swept away.

It has not been possible to study all the cases microscopically or to correlate all the histological pictures with the bacterial findings. It appeared, however, that the feature common to nearly all the cases was what we may call an ulcerative bronchitis and peribronchial pneumonia, the ulcerative process often resulting in a complete dissolution of the walls of the smaller bronchi. The breakdown of this line of defence would make easy the access of any pathogenic organisms in the bronchial tract to the already injured lung tissue. This offers a possible explanation of the variety of bacteria encountered not only in the lung but in the other viscera and the blood stream and also of the frequency of mixed infections.

BACTERIOLOGY. The preliminary examination of sputum from the early cases of pneumonia showed a great variety of organisms, with no striking predominance of one type, and it was thought that the surest evidence as to the identity of the infecting agent could be obtained from cultures postmortem. The results of cultures from consolidated lungs made at the various laboratories in the base section are summarized in Table V. Here, again, a great variety of bacteria were found, the organism most frequently met with being one closely resembling the influenza bacillus of Pfeiffer. (See Table V.)

TABLE V.—CULTURES FROM LUNGS POSTMORTEM.

TABLE V.—CULTURES FROM LUNGS POSTMORTEM.																									
Number of cases	Base Laboratory (1st series).			Base Laboratory (2d series).			Base Hospital No. 33.			Base Hospital No. 29.			Base Hospital No. 37.			A. R. C. M. Hospital No. 4.			Camp Hospital No. 40.			Total.			
	48 cases.			16 cases.			55 cases.			22 cases.			15 cases.			8 cases.			24 cases.			188 cases.			
	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Alone.	Mixed.	Total.	Per cent.
B. influenza	13	24	37	0	8	8	5	15	20	0	0	0	5	5	1	4	5	5	0	8	8	19	64	83	44
Pneumococcus	3	12	15	0	7	7	1	6	7	18	4	22	7	10	10	2	5	7	6	16	33	51	84	44	
Streptococcus hemolyticus	1	5	6	3	4	7	24	8	32	0	4	4	3	6	6	0	1	1	8	2	10	39	27	66	35
Staphylococcus aureus ^a	0	1	1	0	4	4	.3	.2	.5	24
Streptococcus viridans ^a	0	1	1	0	4	4	11	1	2
Meningococcus	1	1	2	0	1	1
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^a Totals and percentages for Staphylococcus aureus and Streptococcus viridans are not included because these organisms were not recorded by all observers.

INFLUENZA BACILLUS. All the organisms reported as influenza bacillus gave characteristic delicate growth on subculture on blood-agar, and morphologically were minute cocco-bacilli or minute rods. In older cultures long thread-like forms and also swollen oval or pear-shaped forms were sometimes seen. A considerable number of these strains were planted in parallel on serum-agar and on whole blood-agar, and all those tested showed characteristic inability to grow on serum-agar. On account of the rush of work it was impossible to complete the identification of all strains, especially during the first part of the epidemic. Up to the present we have also not succeeded in producing a satisfactory agglutinating serum for the identification of these organisms. As far as observed, however, they correspond to the usual description of *B. influenzae*.

PNEUMOCOCCI. The majority of the pneumococci isolated were tested for bile solubility and also for agglutinability in Group I, II, and III sera. At Base Hospital 29 inulin fermentations were also carried out. At this laboratory all the pneumococci recovered postmortem belonged to Group IV. At the base laboratory we obtained two strains of Group I, two strains of Group II, five strains of Group III and 19 strains of Group IV. Of those classed as Group IV several showed a slight agglutination in 1 to 20 dilution both in Group I and Group III serum and one strain agglutinated slightly in all three sera. The reactions, however, in these cases were so feeble when compared with the complete agglutination which occurred when the homologous strains were employed that these organisms were classified as Group IV. Whether many of them may belong to one subtype of this heterogeneous group has not yet been determined.

GRAM-NEGATIVE DIPLOCOCCI. In the earlier cases no record was made of the finding of Gram-negative diplococci in cultures from the lung, as they were regarded as being saprophytes from the bronchi. On account of the frequency with which they occurred, not only in cultures from the lung but also in cultures from the heart's blood or spleen, the later strains were more carefully studied. Of these one pure culture obtained from the lung agglutinated in Type I antimeningococcus serum (Gordon), and one which was found mixed with influenza agglutinated in Type II. Another one associated with the pneumococcus agglutinated with Lederles's polyvalent serum, but failed to agglutinate with any of Gordon's type sera. Of the others most strains produced pigment on subculture or else grew in a dry mass which would not emulsify and were discarded. The few which gave satisfactory emulsion were tested but were not agglutinated by any sera at our disposal. Two strains of a number submitted by Capt. W. Fletcher, R.A.M.C., failed to agglutinate in any of the "Gordon" type sera but agglutinated in Type C of the Pasteur Institute. Two cultures were also obtained by Lieut. Simmons. Of the strains mentioned below, isolated by

Lieut. Stauffer from the sputum and nasopharynx, one agglutinated in polyvalent antimeningococcus serum "Flexner" but not in any of the "Gordon" type sera. The remainder were inagglutinable. It is interesting that apparently 5 cases of meningococcus-pneumonia occurred in this series.

CULTURES FROM OTHER VISCERA. The results of cultures from heart's blood and other viscera are summarized in Table VI. As the routine procedure varied at different hospitals this series is far less complete. Here, again, the picture is confusing. In one case the influenza bacillus, streptococcus and pneumococcus were all isolated from the heart's blood. Another confusing factor was that *Staphylococcus albus* and Gram-negative diplococci of the flavus and catarrhalis types were not infrequently recovered from the heart's blood or from the spleen, which suggested that in these cases the bacterial flora of the respiratory tract gained easy access to the blood stream either shortly before or after death. One fact that seemed evident was that the pleural and pericardial effusions were due either to the pneumococcus or streptococcus and not to the influenza-bacillus. (See Table VI.)

In order to bring out more clearly these variations the reports from the various laboratories have been recorded separately in these tables and the records at the base laboratory divided into those obtained during the first part of the epidemic, and a second series, done during the later part when the cases were less numerous, and it was possible to work out the cultures more thoroughly.

DISCUSSION OF POSTMORTEM CULTURES. The striking feature of the postmortem bacteriological findings was the great variety of bacteria recovered. The findings varied first according to the period of the epidemic. During the first part of the epidemic the influenza bacillus was present in most of the cases as far as our personal observation went, and frequently was the only organism recovered from the consolidated lung. As the epidemic progressed this organism was less frequently recovered, and instances of pure influenza pneumonia were extremely rare. The findings also varied according to the portion of the lung examined. Several bacteriologists reported that in cases in which the recently involved portion of the lung gave a pure or a nearly pure culture of *B. influenzae* the older areas showed pyogenic cocci alone, being mixed with a few influenza bacilli. The findings also varied very strikingly from place to place. At Base Hospital 33 over 50 per cent. of the cases showed hemolytic streptococci, while at most of the hospitals this type of infection was rare, and at Base Hospital 29, pneumococcus Group IV was recovered from every case autopsied.

The majority of the patients in this series came from one transport and became sick while they were in close contact with each other, and were later distributed to the various hospitals in the section. It seemed clear, on epidemiological grounds, that the origi-

TABLE VI.—CULTURES FROM OTHER VISCERA.

	Hearts' blood.				Spleen.			Liver.		Pleural fluid.			Pericardial fluid.				Sphenoid sinus.		
	Base Laboratory (1st series).	Base Laboratory (2d series).	Base Hospital No. 33.	Camp Hospital No. 40.	Base Laboratory (1st series).	Base Laboratory (2d series).	Camp Hospital No. 40.	Base Laboratory (1st series).	Base Laboratory (2d series).	Base Hospital No. 33.	Base Laboratory (1st series).	Base Laboratory (2d series).	Base Laboratory (1st series).	Base Laboratory (2d series).	Base Laboratory (1st series).	Base Laboratory (2d series).	Base Hospital No. 33.		
Number of cases examined	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Number from which growth was obtained	5	13	32	15	7	9	7	6	12	17	5	6	5	10	26	11	5		
B. influenza	3	1	1	0	4	0	0	1	0	0	5	1	0	10	0	9	5		
Pneumococcus	2	6	5	2	1	2	5	2	5	0	0	0	0	10	7	8	4		
Streptococcus hemolyticus	0	0	23	3	0	4	0	1	3	0	0	2	6	0	0	1	0		
Staphylococcus aureus	0	0	0	0	1	0	0	0	0	0	0	1	3	0	0	0	0		
Streptococcus viridans	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0		

* One case Staphylococcus albus only.

nal infection must have been due to one microörganism, and we can only conclude that the various infections observed postmortem were terminal affairs. The fact that certain types of infection predominated at certain hospitals suggested that the terminal infection occurred after admission to the hospital.

The only organism found which could well have been the primary infecting agent was the influenza bacillus, and this was recovered from only 44 per cent. of all the cases. This figure may well be lower than the actual fact on account of the difficulty often found in cultivating this organism when we know it to be present. Its prevalence during the early part of the epidemic and in the recently involved portions of the lung both pointed toward its being the primary agent. In order to secure more definite evidence on this point, cultures were made from blood and from sputum of patients during life.

BLOOD CULTURES. The blood cultures gave little information. When taken from uncomplicated influenza they were uniformly negative. A small percentage of those taken from cases of pneumonia showed the presence of pneumococcus or streptococcus.

TABLE VII.

	Base Hospital No. 204.	Base Hospital No. 33.	Base Hospital No. 29.	A. R. C. Hos- pital No. 4.
Number of cultures	20	16	70	20
Pneumococcus	0	0	4(6%)	8
Streptococcus hemolyticus	0	0	2(3%)	0
Negative	20	16	64	12

SPUTUM CULTURES. The cultures from sputum were more helpful, though by no means conclusive in their results. Thirty-two cases from "Transport 56," only 3 of which had definite signs of pneumonia, were studied by Lieut. Stauffer. The sputum was obtained at the bedside, washed and injected immediately into the peritoneum of a mouse, and also plated directly on blood-agar. At the same time a swab from the nasopharynx was plated on blood-agar. (See Table VIII.) The influenza bacillus was recovered from the sputum in 75 per cent. of the cases and slightly less often from the nasopharyngeal cultures. The pneumococcus was found in the sputum in 10 cases and in the nasopharynx in 6. Seven of the latter were tested for agglutinability and bile solubility and 6 found to belong to Group IV and one to Group II. In regard to the mouse inoculation, it is worth noting that the influenza bacillus was frequently obtained from the heart's blood of the mouse after death, and that the pneumococci, although frequently found in the blood or peritoneal cavity of the mouse, never grew in profuse and almost pure culture in the peritoneum, as is usually the case when mice are injected with the sputum from typical lobar pneumonia.

TABLE VIII.—CULTURES FROM SPUTUM AND NASOPHARYNX.

Thirty-two cases of influenza without pneumonia from "Transport 56."

	Sputum, direct culture.	Sputum injected into mouse.		Naso- pharyngeal swab cultures.
		Peritoneum.	Heart.	
Number of cases examined	29	22	22	24
Influenza bacillus	22	16	15	19
Pneumococcus	9	10	10	6
Streptococcus hemolyticus	1	0	0	3
Staphylococcus aureus	7	7	1	1
Streptococcus viridans	2	2	1	1
Gram-negative diplococci	13	6	4	15

These observations were not made until the epidemic in troops from this transport had begun to subside, and it was quite possible that the original infecting agent might be missed. At this time, however, a number of secondary cases developed among the hospital personnel and among troops in contact with the men of this transport at a rest camp. Forty-eight sputum cultures from such cases made by Lieut. F. B. Harrington (See Table IX) showed the presence of the influenza bacillus in 32; and in 23 of the cases it was found practically in pure culture, being mixed with only a few colonies of the organisms ordinarily found in the upper respiratory tract.

TABLE IX.—SPUTUM CULTURES FROM CAMP HOSPITAL NO. 35,
OCTOBER 10 TO OCTOBER 31.

Influenza alone	23
Pneumococcus alone	7
Influenza and pneumococcus mixed	9
Streptococcus hemolyticus	5
Influenza pneumococcus and streptococcus mixed	1
Streptococcus hemolyticus and pneumococcus	1
Streptococcus and influenza	2

At Base Hospital 29, 70 sputum examinations were made—39 by mouse inoculation and 31 by the Avery tube. The results were:

	Cases.	Per cent.
Pneumococcus, Type II	5	4
Pneumococcus, Type III	7	10
Pneumococcus, Type IV	60	86

The influenza bacillus was not recovered. Of sputa from 7 cases of advanced pneumonia at American Red Cross M. Hospital 4, 2 showed pneumococci alone; 4 pneumococcus and *B. influenzae*; and 1 pneumococcus and streptococcus.

SUMMARY. 1. Epidemiological, clinical and pathological observations of the epidemic of influenza as seen in American troops in England are presented.

2. From the epidemiological findings it appears that we are dealing with a highly contagious acute respiratory tract disease. It further appears that the mortality is about twice as high on board transports as on shore—namely 4 per thousand per month at sea and 2 per thousand per month on shore.

3. The most effective measures found for controlling the outbreak and for diminishing the mortality have been found to be (a) prompt isolation of all men showing temperatures and (b) increasing the amount of space allotted to a man. No conclusive evidence is at hand that masking and prophylactic spraying are effective, but the authors believe that these measures may properly be carried out, but are not to be solely relied upon.

4. In the matter of hospitalization it appears pretty definitely that it is highly important that cases be moved as little as possible and that they be got to bed with a minimum of delay. Long journeys in hospital trains are distinctly inadvisable.

5. In regard to the higher mortality seen at sea it is probable that various debilitating circumstances, such as unpalatable and hence insufficient food, broken and insufficient sleep, poor ventilation, overcrowding and exposure to cold and wet, all may have served to lower the individual resistance to the disease. But it is probable that the high mortality was determined not so much by these factors as by the virulence of the infecting organisms. It must be borne in mind that the troops were all newly recruited and that they left cantonments where a highly virulent organism was prevalent.

6. Clinically, it seems probable that the original infection is an entity. That when uncomplicated the mortality is nearly zero, but that bronchopneumonia frequently develops and is responsible for practically all the deaths. The type of bronchopneumonia is unusual. It may be exceedingly fulminating and almost explosive in extension, or it may be subacute, running a course of ten days to two weeks. It is usually associated with a purulent bronchitis. The cause of death in the fulminating cases may be suffocation, in the less rapid ones toxemia. The peculiar features of the pneumonia are the deep cyanosis, with no cause obvious in the circulation, the absence of pain and orthopnea, the frequent epistaxis, the purulent and blood-streaked sputum and the leukopenia.

7. No curative measures of value have been found. In the pneumonia, oxygen administered may or may not alter the cyanosis, but in any event does not seem to alter the course of the disease. Treatment in general must necessarily be entirely symptomatic. Venesection and saline infusion have not shown any beneficial effect. Digitalis has been used extensively, but in the majority of cases there is no clear-cut evidence of cardiac incompetence.

8. As to etiology it is impossible, from the reported findings, to draw definite conclusions as to the primary infecting organism. The streptococcus, pneumococcus, staphylococcus and meningococcus were found so irregularly that we believe they can be excluded as secondary invaders. The influenza bacillus was found post-mortem frequently, but by no means constantly. However, it was found more frequently in the early part of the epidemic than in the late, and in the early cases it was often the only organism in the consolidated lung. It was found more frequently in the freshly consolidated lung than in older lesions. It was also found with considerable regularity in the sputum and nasopharynx of grip cases uncomplicated by pneumonia. These facts seemed to indicate that the Pfeiffer bacillus was the primary cause of the epidemic, though the evidence is not conclusive. The observations of Charles Nicolle at Tunis of the presence of a filterable virus offer an alternative explanation. In conclusion, we can only state that this epidemic was due to infection by either the bacillus of Pfeiffer or by some microorganism not recoverable by the methods employed.

THE UNIDENTIFIED PANDEMIC DISEASE (INFLUENZA?).

BY DUDLEY ROBERTS, M.D., MAJOR, M.C., U.S.A.,

NEW YORK.

THE pandemic of acute respiratory disease which started in Europe in 1918 is still unidentified. Clinically and pathologically it is a new disease, differing widely from familiar maladies and epidemics within our experience or described in the literature of medicine. The etiology, in fact, of epidemics which have come down through history as "influenza" is fully as uncertain as the present one, during which the opportunities for accurate laboratory study have been unprecedented. The ultimate solution of this problem must rest with the bacteriologist.

The disease is still epidemic in many quarters and the persistence of scattered cases when the epidemic first appeared makes it extremely probable that it will be added to the category of endemic contagious diseases. The prompt recognition of isolated cases is exceedingly important for the individual and the community. An opportunity for the study of the disease has been offered in our military hospitals, which is not liable to be duplicated.

The clinical material on which this communication is based comprises about 1500 cases under observation from the beginning of the epidemic until the middle of December at U. S. Army General Hospital No. 1 (Columbia War Hospital), Williamsbridge, N. Y.;

about 200 cases at U. S. Army General Hospital No. 25, Fort Benjamin Harrison, Indiana.

CLINICAL CHARACTERISTICS. The disease is almost always sudden in its onset, with headache and general malaise, followed in a few hours by a chill or chilly feeling and a sharp rise of temperature. Occasionally there are mild prodromata for several days. Usually at onset the eyes, nose and throat feel scratchy and early appear congested. The red, dry eyes are strikingly characteristic. Inflammatory changes in the pharynx and tonsils are rarely shown. The face and entire body present a flushed, congested, almost cyanotic appearance in the more severely ill. The apathy of the patients is extreme, the chief desire being to be undisturbed. Prostration does not accurately describe the condition, as the body is frequently in universal flexion and the patient sits up energetically if sufficiently aroused.

Cough is almost always present from the outset. Substernal distress or pain is common and sometimes decidedly out of proportion to the severity of the cough. The temperature elevates quickly to 101° to 104° F. The pulse and respirations are not accelerated until late in the disease. Nose-bleed is common, continuing intermittently for several days in the more severe cases.

In the mild or uncomplicated cases the temperature reaches normal in forty-eight hours, elevating possibly at night for a day or two more. Persistence of temperature beyond the third day is to be regarded as an evidence of deep invasion of the pulmonary tissues.

The leukocyte count is low almost without exception. Counts of 2000 to 3000 were not unusual and a leukocyte count of 9000 to 10,000 was looked upon with suspicion. Blood cultures were universally negative early in the disease. Albumin and casts in the urine was the rule in the more severely ill.

We are dealing then with an acute infection which in approximately 80 per cent. of cases lasts only two or three days, characterized by rapid onset, substernal pain and cough, suffusion of the eyes, face and body, but without much evidence of coryza, tonsillitis or pharyngitis. On the return of the temperature to normal the patient is not strikingly weak.

COMPLICATING CONDITIONS. Inflammation of the larynx occurs after the first week or ten days in approximately 5 per cent. of cases, manifesting itself by hoarseness, pain in the larynx and sometimes a well-developed aphonia.

Nausea and vomiting in the first days of the disease occurred frequently in the more severely ill. In a few cases vomiting was persistent and prostrating. Hematemesis was seen in two fatal cases, both at autopsy, showing a hemorrhagic gastritis with superficial erosions. The term "gastro-intestinal type" may be used to describe those cases in which vomiting is a feature of the disease, but the

constant lesion is pulmonary and a fatal outcome is the result of the peculiar pneumonitis.

A scarlatiniform rash which could only be differentiated from scarlatina by the absence of the characteristic tongue and throat was seen six times in our series. While this disease prevails a diagnosis of scarlatina should be guarded, especially when there is evidence of respiratory involvement.

Femoral phlebitis occurs occasionally late in the disease. It is, so far as our experience goes, merely a long protracted disabling condition.

In many severe cases the urinary output is low and the albumin and casts of all kinds in the urine abundant. We could not see that this was a matter of great clinical importance. Toxic symptoms referable to the kidneys were not observed. Apparently the kidneys were excessively congested and acutely inflamed, but the recovery of function was rapid and complete as the disease subsided.

Meningitis is said to have occurred, but it is our opinion that the meningeal symptoms are toxic. In the one real meningitis seen during convalescence from a supposed "influenzal meningitis," an abundant growth of meningococcus was obtained from the retropharynx. In another tubercle bacilli were found in the spinal fluid.

A mild happy delirium which leads to an exaggerated sense of euphoria is common in the more severely ill. Late in the disease an unreasonable active delirium was occasionally seen. The mental state in the disease undergoes interesting changes; at onset there is striking apathy, later euphoria, and finally in some fatal cases an active or low muttering delirium.

PNEUMONITIS. The trachea and larger bronchi are regularly the site of infection and the spread of the inflammatory process largely determines the severity of the disease. In the mild cases signs of bronchitis are absent. As the disease spreads along the bronchial tree an intense congestive serohemorrhagic inflammation of the mucosa develops, with more or less peribronchial exudate or infiltration. Lobules are then picked out and more or less consolidated by an exudate poor in leukocytes and fibrin and rich in red cells. These lobules may fuse into large lobar consolidations, with a characteristic exudate. There is then a peculiar type of tracheitis, bronchitis and bronchiolitis, with or without scattered areas of peribronchial or lobular pneumonia, with or without typical lobar pneumonia. The characteristic process is a generalized serohemorrhagic pneumonitis. It is impossible to draw a sharp line of distinction between the pneumonias and the "not-pneumonias." From this fact has arisen much confusion. Clinically the cases fall rather sharply into four groups:

GROUP 1. *Mild Peribronchial Cases.* These patients do not seem much worse than those who recover perfectly in two or three

days. The temperature is practically normal, but they continue to cough and feel poorly, frequently breaking out in cold perspiration on the slightest exertion. While the physical signs may not be conclusive the radiographs show more or less peribronchial infiltration. They continue to cough and feel weak for several weeks, and probably during this period are a source of danger to those about them.

GROUP 2. *Recrudescence Cases.* After one to seven days of apparent convalescence from a mild form of the disease a few patients were suddenly taken with a chill, cough, bloody expectoration and a rise of temperature. Usually these cases immediately showed signs of massive consolidation. It seemed probable that there had been a cross-infection in the wards after recovery from the original infection.

GROUP 3. *Severe Toxic Cases.* Usually from the onset a severe infection evidenced itself by the appearance of the patient, the bloody expectoration and the harsh breathing throughout the chest. Frequently it was obvious that the outlook was hopeless solely from critical inspection rather than definite evidence of cardiac failure or pulmonary inflammation. The sputum in these cases is either a thick, tenacious, blood-tinged sputum or less frequently a thin serosanguineous fluid or even pure blood.

GROUP 4. *Fulminant Form.* The course of the disease is occasionally very rapid, death following the time of "giving up" by only a few hours. The cyanosis is extreme, the dyspnea and anxiety frightful. In this group the congestion, exudation of serum and actual hemorrhage into the bronchi and alveoli is exceptionally severe and the patient is drowned in his own fluids. The pulmonary edema is not due to cardiac failure but to an unusual reaction of the tissues to this peculiar infection.

DIAGNOSIS. During an epidemic the diagnosis is usually simple. At any time a severe case would at once strike the clinician as being a different disease. Mild isolated cases would be diagnosed with difficulty. They closely resemble typhoid in many symptoms and laboratory findings. Diagnostic tests were watched from day to day in several instances late in the epidemic, in the expectation that a diagnosis of enteric fever would be justified. The spleen may be palpable and slightly suggestive spots be found on careful scrutiny. Many diseases are and will continue to be called "influenza" that are not. This mistake will seldom occur if one recognizes that the infection is pulmonary and the severity of the disease proportional to the pulmonary involvement. The early recognition of the pneumonia is frequently difficult, as actual lobar consolidation may never develop even in the case that terminates fatally as late as the tenth or twelfth day of the disease. Clinically the diagnosis rests on the appearance of the patient, the bloody sputum, slight changes in voice and breath sounds over small areas and the presence of crepitant rales. Reliance on physical signs is dangerous.



FIG. 1.—Arrow 1, peribronchial infiltration; arrow 2, slight extension to the upper lobe along the bronchial tree; arrow 3, similar extension to the right base.

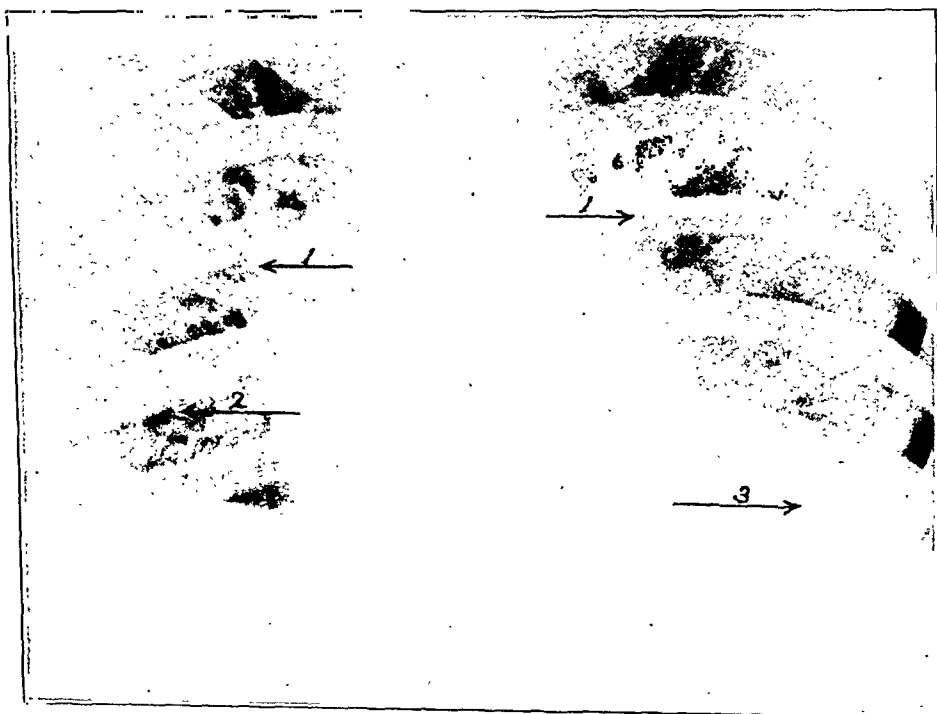


FIG. 2.—Arrow 1, peribronchial infiltration; arrow 2, slight exaggeration of the bronchial tree; arrow 3, beginning consolidation at the left base.

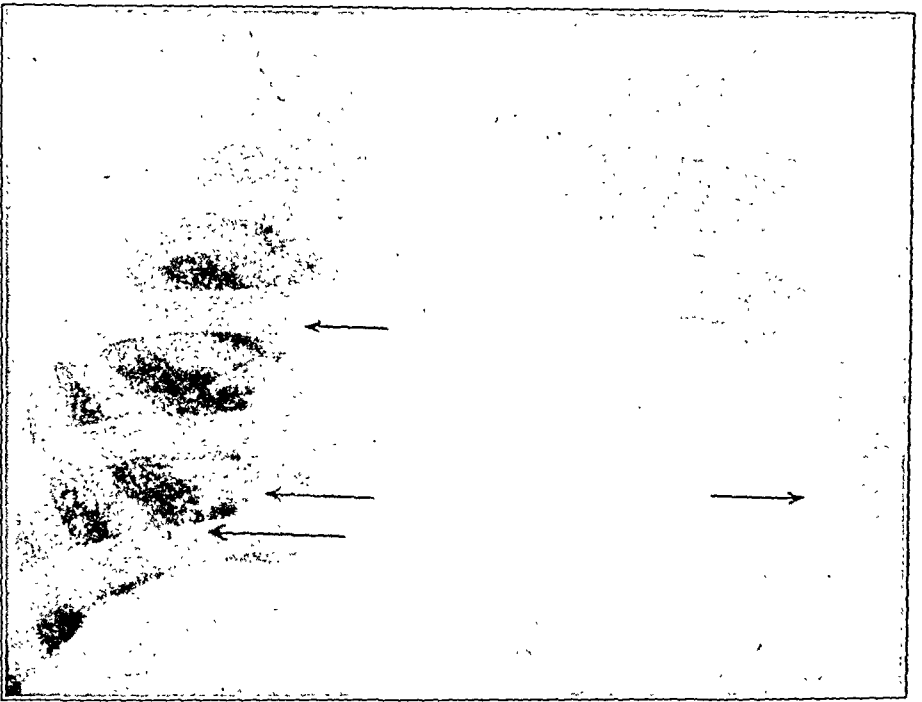


FIG. 3.—Root infiltration with beginning consolidation at both bases. Physical signs at the bases in this stage only; slight dulness, rales, prolonged high-pitched expiration and somewhat high-pitched voice.

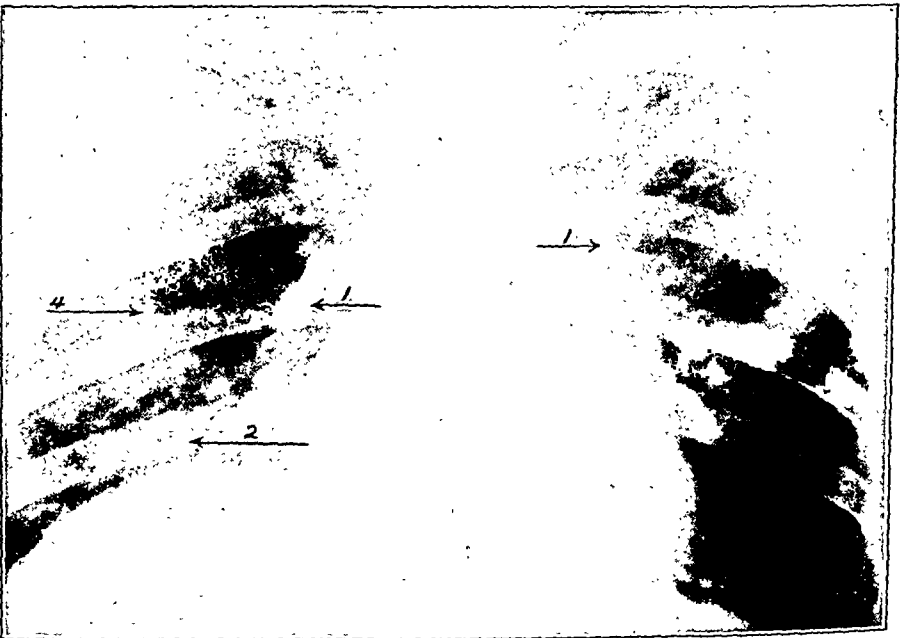


FIG. 4.—Arrow 1, root infiltration; arrow 4, diffuse process in and outside the bronchi; arrow 2, extension to the base as shown on next plate.



FIG. 5.—Scattered lobular consolidations, with a diffuse peribronchial infiltration and intrabronchial exudation. Definite consolidation at arrow 1, signs of which are heard high in the axilla.

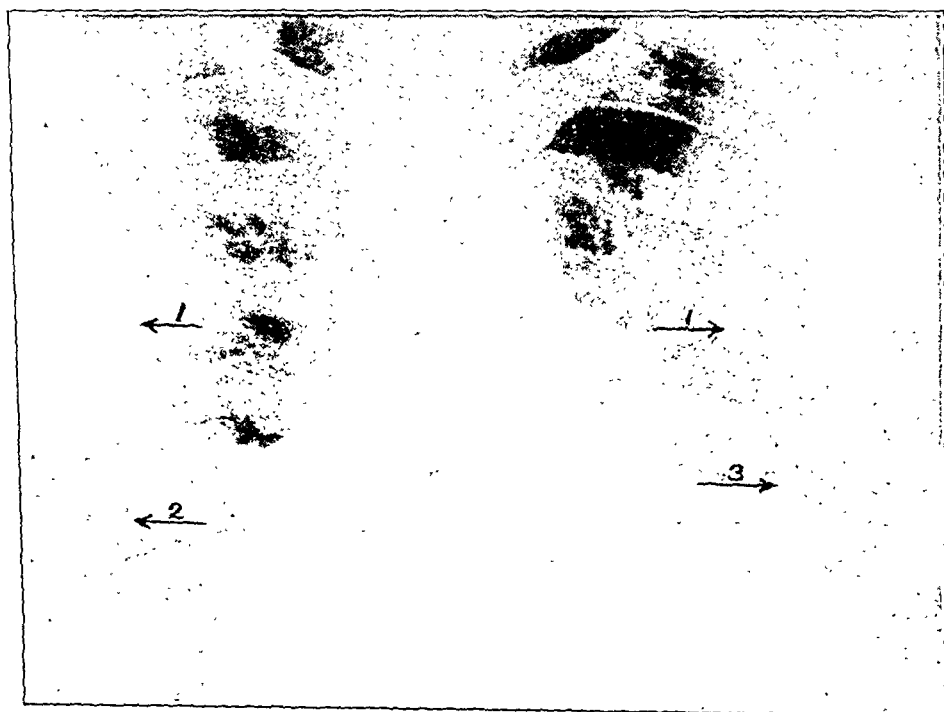


FIG. 6.—Very diffuse process, with definite consolidations at the arrows. This consolidation of the lobular type, some air in the affected lobes, signs not absolutely complete.

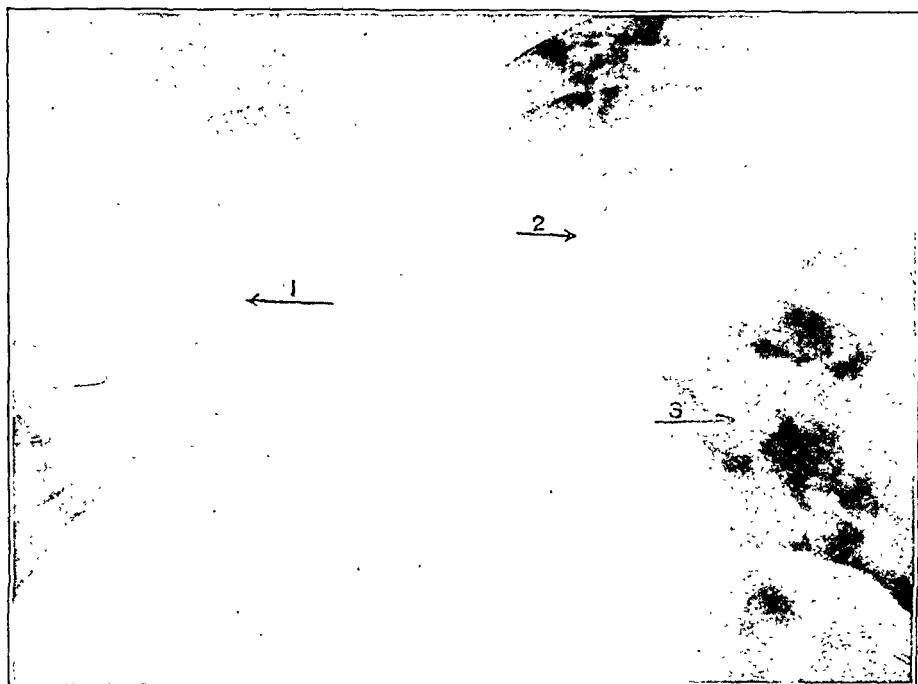


FIG. 7.—Taken forty-eight hours after Fig. 6.—Massive consolidations at arrows 1 and 2, with diffuse process at arrow 3 and elsewhere.

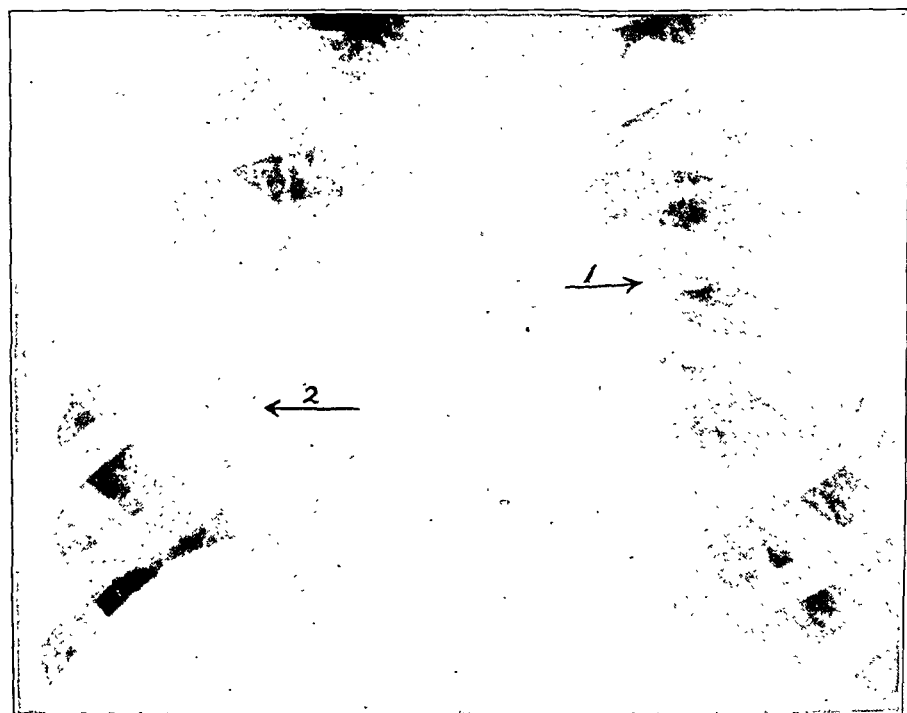


FIG. 8.—Arrow 1, peribronchial infiltration; arrow 2, complete consolidation of the middle lobe; general exaggeration of the bronchial tree from the serum in the bronchi and infiltration around.

COURSE OF PNEUMONIA CASES. In Chart I is shown the percentage of deaths on different days of the disease. There were few before the fifth day and very seldom one after the eleventh.

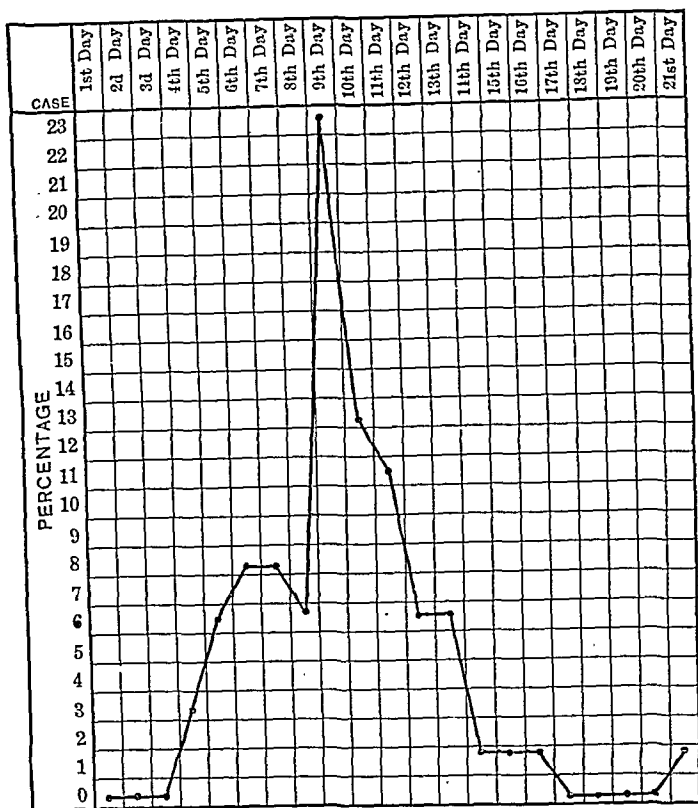


CHART I.—Mortality chart. Death incidence on different days of disease.

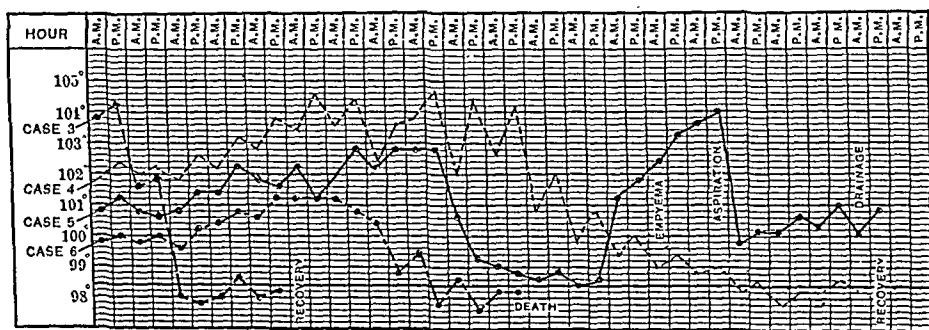


CHART II.—Showing variations in temperature curve. Case III. Short form of pneumonia with natural crisis. Case IV. Obstinate form, temperature normal by lysis on twentieth day. Case V. Fatal case in spite of fall of temperature to normal. Case VI. Pneumonia with crisis and temperature rise from empyema.

In Chart II is shown the number of cases reaching convalescence on different days of the disease and admission to the hospital. Late in the epidemic a number of cases were seen that ran a mild but prolonged course.

Recovery came by crisis in only 20 per cent. of cases treated symptomatically, but the crisis in this disease is not the striking phenomenon seen in pneumococcus lobar pneumonia.

The Obstinate Cases. Prolonged fever and delayed convalescence were always watched with suspicion and the patient frequently radiographed for evidence of empyema. There are, however, cases in which the long-continued illness is due entirely to a pneumonitis without other lesion.

Empyema Incidence. In the series of cases treated symptomatically few empyemas developed, although at autopsy conditions were found that suggested the probable development of pus had the patient not died so promptly. In the "protein injection series," in which the death-rate was much later, seven empyemas were drained by operation and three subsided following simple aspiration. We were confirmed in the opinion formed during the "streptococcus pneumonia" epidemic of the previous winter that the early recognition of complicating empyema depended upon routine radiography and exploratory puncture.

Pneumothorax and Subcutaneous Emphysema. Spontaneous pneumothorax has been a peculiar complication of this disease. Frequently the cavity has been small and impossible of recognition except on careful study of the radiograph. Subcutaneous emphysema involving the upper chest and even the entire trunk has been seen a number of times. The two conditions may be associated. The rupture is probably due to the excessive dilatation of the lobules of the upper lobes. Of the five cases of emphysema coming under observation none were fatal.

PROGNOSIS. The mortality of the disease, judging from reported figures, has been from 5 to 10 per cent. of all cases affected and 25 to 40 per cent. of all recognized pneumonias.

Prognosis in the individual case is usually possible from the first few days of the disease, when one becomes familiar with the appearance of the sick patient and is not led astray by the slow pulse and respiration rate, the low temperature and the absence of signs of consolidation. The temperature may fall to normal several days before death, rising only immediately before the end. Death does not come essentially from cardiac failure. Usually the respirations become shallow and rapid, the dusky pallor more pronounced and consciousness becomes constantly clouded. In this condition the patient may last several days.

RADIOGRAPHIC STUDY OF THE PATHOLOGY. The radiographic findings are very different from lobar pneumonia in which an exudate into the alveoli and a proportionate absence of air gives rise early to unmistakable densities. The bedside portable apparatus made possible the daily routine study of a large number of cases, some of which were later studied at the autopsy table.

In the simple "influenzas" the radiographic findings were negative.

Apparently the pathological process was so limited to the trachea and larger bronchi that abnormal densities were not shown. In the pneumonitis cases the radiographic studies showed the same wide variation in site and density of lesion that were shown at autopsy. In general it may be said that these varying pictures were made up of four elements, as follows: (1) The enlarged hilum markings, apparently the result of exudation within and around the larger bronchi; (2) an exaggeration of the shadow of the bronchial tree caused by an extension of the process to the smaller bronchi and bronchioles; (3) irregularly scattered densities that represented areas of lobular consolidation; (4) large areas of density arising from the consolidation of a large portion of an entire lobe or lobes. The first, second and third elements are to be regarded as progressive steps in the process. An excellent idea of the prognosis could be obtained by serial radiography. The severe toxic cases always showed early the irregularly scattered densities of lobular consolidation. The lobar consolidations developed either as a result of the fusing of the lobular process as seen day by day radiographically or developed rather suddenly in an area such as the extreme base or the middle lobe which on the plate twenty-four hours previously had seemed unaffected. These studies confirmed our opinion reached from the clinical side that the pathology of the disease as seen at autopsy was first the characteristic serohemorrhagic pneumonitis extending along the bronchi, and second the incidental development of lobar consolidations with the classical exudate into the alveoli. We were satisfied that the prognosis was comparatively good in the cases which developed definite lobar consolidations without generalized bronchial and peribronchial exudate and lobular consolidation.

TREATMENT OF THE DISEASE. Aside from rest in bed and isolation from other patients to prevent cross-infection it was unnecessary and useless in the majority of cases to attempt interference with the course of the disease. Even the relief of symptoms by drugs was found unsatisfactory. The question arises whether anything can be done to limit the spread of the inflammatory process and assure recovery. A well-controlled series of cases was treated by the hypodermic administration of mixed vaccines immediately on admission, with no apparent result. It seems possible that the increase of the dose of the injection to the point of causing a protein reaction would be justified as a routine as soon as possible after the onset.

The recognized pneumonia cases were isolated in special wards and each protected from the other with every possible care. Rest was insisted upon, if necessary by mild hypnotics or codein or morphin. A large proportion of our patients were digitalized as soon as possible, using a large dose of the standardized tincture. The conclusion was reached that the practise was free from danger and that it was possibly useful in a small number of cases. Cardiac

failure was not the cause of death, and without digitalis few patients showed any evidences of fibrillation until they were actually mori-

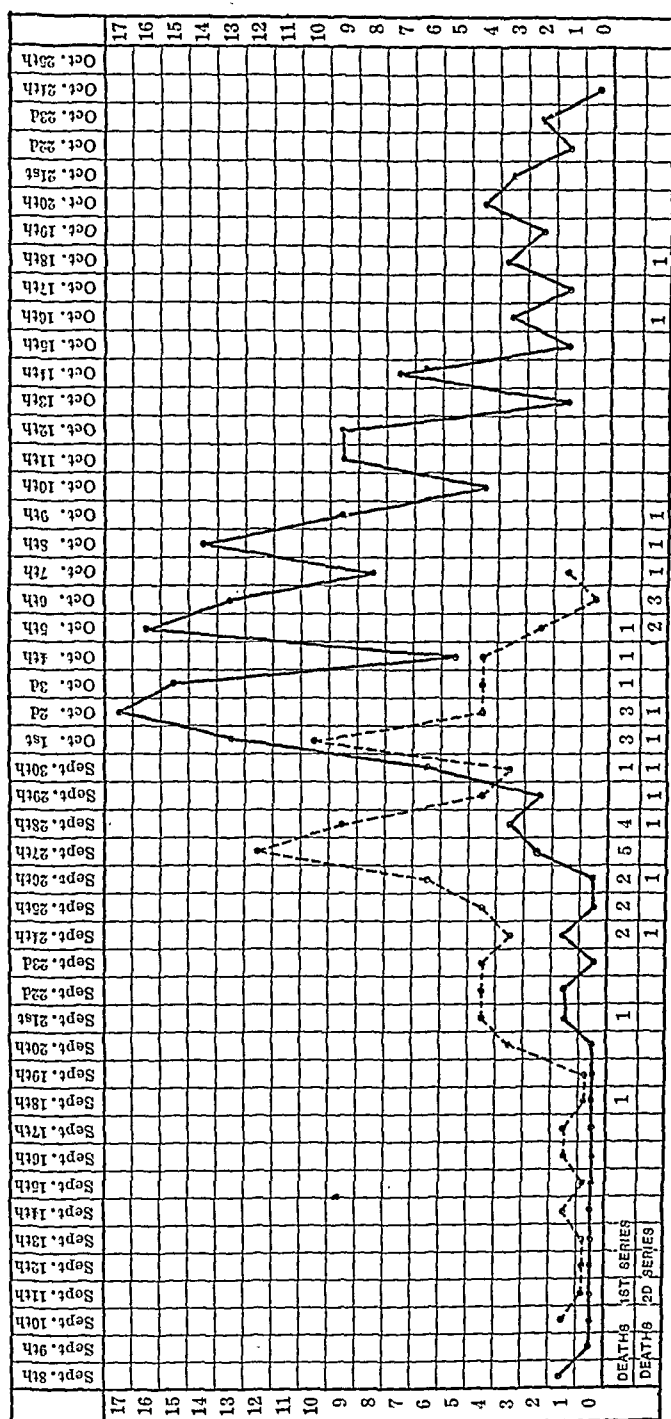


CHART III.—Incidence of onset of pneumonia cases in two series. Broken line, first series, expectant treatment. Solid line, second series, bacterial protein injections. Figures below show the fatal cases in each series. Note.—During period prior to October 5 the death-rate in "protein injection" series was 11.9 per cent. against 31.3 per cent. in the first series. Total mortality: first series, 31.3 per cent.; second series, 9.6 per cent.

bund. As a quick diffusible stimulant, camphor in oil seemed most useful. Pituitrin was of great value in the relief of abdominal dis-

tention. Whisky has again come into favor in the handling of these pneumonias, although from our experience it has no particular

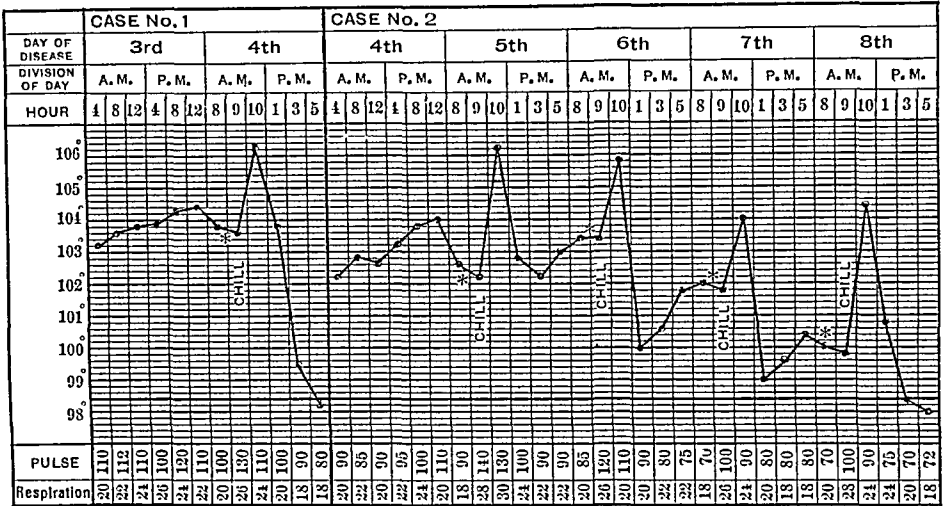


CHART IV.—Illustrating characteristic "protein reaction." Asterisk indicates the time of protein injection, regularly one-half hour before the chill. The charts give the complete febrile course of the disease in each case.

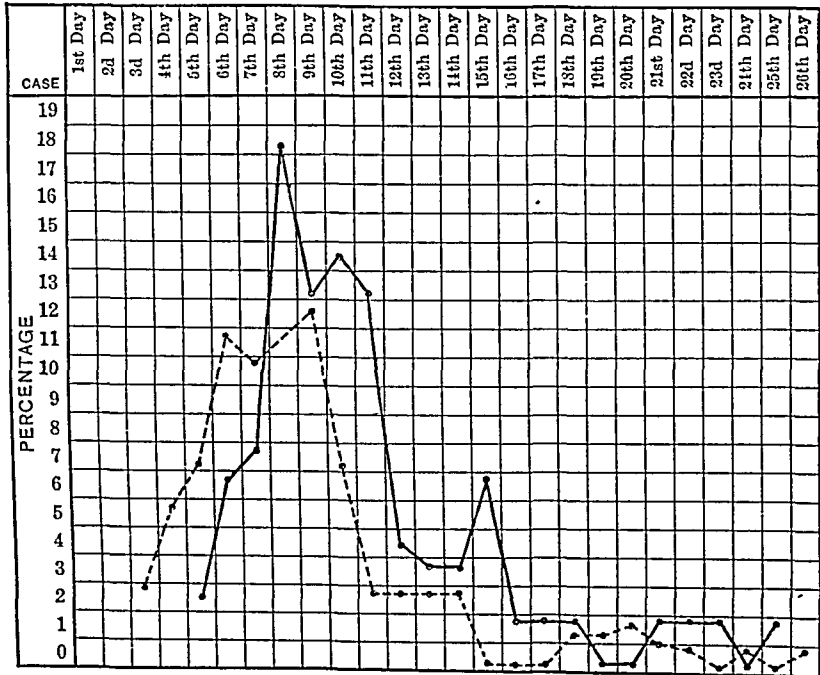


CHART V.—Showing percentage of cases reaching normal temperature on successive days of the disease. Solid line, first series, 86 cases, expectant treatment. Broken line, second series, 200 cases, protein injection treatment.

value. Cupping, counter-irritation and pneumonia jackets have proved entirely useless. Phlebotomy has occasionally given slight relief, but it has never shown the salutary effect on pulmonary

edema that is frequently seen in the sthenic type of lobar pneumonia with right-sided heart failure.

INTRAVENOUS BACTERIAL PROTEIN INJECTIONS. Our experience with specific plans of treatment has been largely confined to the use of mixed vaccines sufficient in amount to produce a definite "protein reaction."¹ In the small number of cases in which transfusion from recovered patients was tried the results were disappointing. In a few cases a polyvalent antipneumococcus vaccine was used without apparent result.

Because of the appalling mortality under an expectant plan of treatment we started on October 3 to use intravenous injections of a mixed influenza vaccine, and contrary to our original idea we soon concluded that good results were only secured when the injection caused a definite "reaction." At the present time we regard the exact composition of the vaccine as a minor matter, but believe that to secure the reaction the initial dose should be approximately 1,000,000,000 heat-killed organisms injected intravenously, and probably several times this dose if administered subcutaneously or intramuscularly. The typical reaction is shown in graphic Chart I to consist of a chill or a definite chilly sensation one-half hour after the injection, accompanied by a rise in pulse-rate and sometimes by a slight fall in temperature. The temperature then elevates, quickly reaching a maximum in a half to one hour, when it falls, sharply, as a rule, but usually rises again. The rise following the chill is always transitory and is overlooked unless temperatures are taken every half-hour. The subsequent fall may be to normal after the first, second or third injections, the disease terminating by crisis. After the chill the patient almost invariably feels greatly improved and the change in appearance and lung signs is often striking. The injections have routinely been repeated every twenty-four hours, although a shorter interval may be found to be an improvement. No ill effects have ever been attributable to the treatment.

COMPARATIVE MORTALITY. In a consecutive series of 200 cases of definite influenza pneumonias treated by this plan the mortality was 9.6 per cent. This was in striking contrast to a series of 86 consecutive cases treated by an expectant plan with a mortality of 31.3 per cent. No case was excluded from either series because of the hopelessness of the condition of the patient on admission. During a period in which the cases in the two series overlapped in the incidence of onset there was the same relative mortality as is shown in Chart III. The betterment in results cannot be attributed to a difference in the period of the epidemic.

By this plan of treatment not all cases can be saved, but we were convinced that many cases which were naturally fatal recovered promptly in the most striking manner.

¹ Jour. Am. Med. Assn., 1919, lxxii, 22.

Non-specific protein injections have already found considerable favor in the treatment of the arthritides. It would seem from our experience that it offers great possibilities in the treatment of any acute infectious disease, but particularly of one with an unknown etiology and consequently no possibility of producing an immune animal serum.

PNEUMONIA AS A COMPLICATION OF EPIDEMIC INFLUENZA.

BY CAPTAIN A. V. BOCK, M.C., U.S.A.,

BOSTON, MASSACHUSETTS,

AND

CAPTAIN J. L. STODDARD, M.C., U.S.A.

BOSTON, MASSACHUSETTS

(From the Medical Service and Laboratory of U. S. A. Base Hospital No. 5.)

INTRODUCTION. The material for this study was formed from 39 cases of pneumonia occurring in the course of the epidemic of influenza in Flanders and northern France during the fall of 1918. The patients, fourteen of whom were British and twenty-five of whom were American soldiers, were sent to this hospital, in Boulogne, between October 25 and December 7, 1918, from twelve widely separated field hospitals and casualty clearing stations. The most striking feature of the series was that 25 of the 39 cases had lobar pneumonia due to pneumococcus infection. This diagnosis was supported by bacteriological evidence in the form of positive blood cultures. The high mortality allowed confirmatory evidence as to the character of the lesion at necropsy.

Various papers on the pandemic of influenza which occurred during the fall months of 1918 have shown that lobar pneumonia was seldom found. A few studies, however, reported it as of frequent occurrence. It is evident that the nature of the pulmonary changes varied in different districts and countries. According to Horder's¹ observations in St. Bartholomew's Hospital, London, the respiratory manifestations extended from laryngitis and tracheitis through bronchitis to lobular and lobar pneumonia. But the characteristic feature, and one which was seldom absent in any severe case, was a condition of capillary bronchitis with intense pulmonary congestion. Cases of true bronchopneumonia did not seem common. On the other hand, Christian,² at the Peter Bent Brigham Hospital, Boston; Keegan,³ at the United States Naval Hospital, Chelsea; Nuzum, Pilot, Stangl, and Bonar,⁴ in Cook County Hospital, Chicago; Friedlander, McCord, Sladen, and Wheeler,⁵ at Camp Sheridan, Ohio; Synnott and Clark,⁶ at Camp Dix, New Jersey; Abrahams, Hallows and French,⁷ in the Connaught

Hospital, Aldershot, and Blanton and Irons,⁸ at Camp Custer, Michigan, found bronchopneumonia in their fatal cases and believed that true lobar pneumonia was uncommon in association with influenza. In contrast to this opinion, Muir and Wilson,⁹ of the Third and Fourth Scottish General Hospitals, Glasgow, found lobar pneumonia, or a combination of lobar and bronchopneumonia, in 34 per cent. of 26 necropsy examinations; Hall, Stone, and Simpson,¹⁰ at Camp Logan, Texas, made a diagnosis of lobar pneumonia in all but 50 of 416 cases of influenza-pneumonia. These cases, under observation between September 13 and October 8, 1918, are the only ones reported in which lobar pneumonia was the chief complication.

A great diversity of bacteriological findings has also been characteristic of the epidemic. Keegan³ recovered the bacillus of influenza from the lungs at necropsy in 82.6 per cent. of 23 cases of post-influenzal bronchopneumonia, and McIntosh,¹¹ in the London Hospital, isolated the same organism in 68 per cent. of 19 fatal cases of bronchopneumonia. These results are in striking contrast to the work of others. Blanton and Irons⁸ recovered streptococci from 451 of 740 sputa and pneumococcus 148 times. The streptococcus was also the chief organism isolated by Fildes, Baker and Thompson¹² at the Royal Naval Hospital, Haslar, England and by Strouse and Bloch¹³ in Michael Reese Hospital, Chicago. The pneumococcus, on the other hand, is described as the predominating organism by Nuzum, Pilot, Stangl, and Bonar,⁴ who recovered this organism from the lungs at necropsy in 75 per cent. of 34 cases, and by Friedlander, McCord, Sladen and Wheeler,⁵ who found it regularly in the sputum of 2000 cases having pneumonia and from cultures at necropsy in 53.3 per cent. of a large series of fatal cases. Similar results were obtained by Hall, Stone and Simpson,⁹ who isolated the pneumococcus from the sputum of 302 pneumonia patients. Other writers, notably Abrahams, Hallows and French,⁷ placed emphasis upon a diplostreptococcus as a chief secondary invader. Whittingham and Sims,¹⁴ of the Central Hospital and Military Hospital, Hampstead, England, found *Micrococcus catarrhalis* the predominating organism in 34 per cent. of 50 consecutive cases of influenza, and finally Fletcher,¹⁵ in the University War Hospital, Southampton, England, and others have found the meningococcus in pure cultures. Blood cultures, by many of the workers mentioned, have yielded negative or indifferent results.

In brief, experience has shown that bronchopneumonia has been the common severe pulmonary complication of influenza, whereas lobar pneumonia has been one of infrequent occurrence. Furthermore, the etiology of the pneumonia has been attributed to many organisms, among them the bacillus of influenza, streptococcus, pneumococcus, diplostreptococcus, *Micrococcus catarrhalis* and meningococcus.

METHODS OF STUDY. Many patients having influenza were admitted to this hospital during the epidemic. The frequent complication of lobar and bronchopneumonia necessitated the isolation and individual care of those who were found to be most seriously ill. The patients in this series represent, therefore, a selected group of especially severe cases. They were observed in an isolation ward of thirteen beds, each bed being in a separate cubicle. Special nurses were on duty day and night, and all persons who came in contact with the patients wore protecting gowns and masks. In every case a careful history and physical examination was made upon admission and daily chest examinations were made thereafter. No special treatment was given except for the routine administration of digitalis and the forcing of fluids.

The cases were studied more closely by the following laboratory methods:

1. *Blood Cultures.* Whenever possible a blood culture was made in every case upon admission to the ward. If negative, it was repeated once or twice in several cases. Ten centimeters of blood were obtained by venepuncture and inoculated into a large tube containing 50 cm. of 1 per cent. glucose broth. The cultures were examined at the end of twenty-four and forty-eight hours. The pneumococcus, which was the only organism recovered from the blood stream, was identified by the following characteristics:

- (a) Greenish culture in blood bouillon.
- (b) Diffuse cloudiness in bouillon with no flocculent precipitate and very little settling.
- (c) Pneumococcus-like colonies on blood agar.
- (d) Bile solubility (not always tested).
- (e) Typing with sera distributed by the Rockefeller Institute.

2. *Sputum and Lung Cultures.* Stained smears of sputum were examined in all cases in which specimens were obtainable, and attempts were made to isolate the pneumococcus by Avery's¹⁶ method. Lung cultures were made in a few cases in which sputum was unobtainable.

3. *Necropsy Examinations.* Necropsy examinations were made as soon as possible after death. Cultures from this material were not extensively studied.

LOBAR PNEUMONIA. The histories of the 25 cases of lobar pneumonia were essentially the same as in the cases of bronchopneumonia. The common story was one of sudden onset of fever, marked prostration and generalized aching pains characteristic of influenza. Many cases of influenza were seen in the hospital, in which recovery from the acute attack had occurred, but which developed pneumonia within one to four days afterward. Three such cases are included in this series. In the majority of cases, however, no history of an afebrile period preceding the pneumonia could be obtained. The diagnosis of lobar pneumonia was made upon the physical signs of

consolidation in the lungs. Such signs were usually found at the time of the first examination. Other factors considered were the temperature curve, toxemia, course of the disease and character of the sputum.

In 8 surviving cases signs of frank consolidation were found as follows: Right lower lobe, 5; both lower lobes, 1; right lower and right upper lobes, 1; both lower and right upper lobes, 1; in 17 fatal cases the lobes involved were: Right lower lobe, 1; left lower lobe, 4; both lower lobes, 6; both lower and right upper lobes, 1; both lower and left upper lobes, 1; left lower and left upper lobes, 1; right lower and right upper lobes, 1; In the 2 remaining cases there were signs of consolidation in one side and diffuse variable signs characteristic of bronchopneumonia in the other.

The temperature curve during the height of the disease was well sustained, usually between 102° and 105° . Crisis occurred in 1 case and the temperature fell in seven others by lysis. Probably crisis did not occur in more of the cases because of the extension of pneumonia to new lobes or to concurrent bronchopneumonia. There was, as well, a notable failure of the lobes which were first affected to show signs of resolution even after ten to fourteen days of complete consolidation. Such a spreading lesion with slow resolution indicated either a low resistance to the invading organism or an extremely virulent infection.

All of the patients showed severe prostration, rapid respirations and cyanosis of varying degrees. Delirium was a frequent symptom.

The sputum in the majority of cases was characteristic. Early in the disease it was blood-stained, semigelatinous, mucoid pus, which persisted in certain cases but usually changed to a purulent excretion. Extension of pneumonia to new lobes was often first noticed by the reappearance of blood-tinged mucus. None of the cases produced an unusual amount of sputum and in several instances no specimens could be obtained.

Of 25 cases of lobar pneumonia, 17 died and 8 lived. The average duration of pneumonia in the surviving cases was nine days; in the fatal cases, twelve days. These figures are only approximately correct, since it was impossible to determine the exact date of the onset of pneumonia except in a few cases. Other points of clinical interest were: The occurrence of laryngitis in 2 cases; jaundice in 1 case; sterile pleural effusion in 2 cases; empyema in 1 case; pleural pain at some time in 10 cases; 2 cases of purulent pericarditis and 4 cases of empyema found at necropsy were not diagnosed during life.

BRONCHOPNEUMONIA. The diagnosis of bronchopneumonia was made in 14 cases upon the physical signs, as in the other series; but other data, such as the temperature curve, toxemia, sputum and the course of the disease were included. The cases were in no respect different from those described as bronchopneumonia by

other writers, with the exception that very little tendency to hemorrhage was observed.

One of the characteristics of the lung signs was the great variation noticed from day to day. For varying periods in some cases there was complete absence of pathological signs. Suppressed breathing at the bases was common. Moist, sticky, consonating rales were often present, and frequently patches of bronchial breathing in the interscapular spaces or near the scapular angles. During the closing days of the disease, in a few fatal cases, consolidation of one or both lobes was noted. In 6 cases no bronchial breathing was heard and in 8 it was found at some time during the course of the disease.

In several cases a high temperature curve persisted until death, but, as a whole, variations of as much as 5° between the morning and evening temperatures were not uncommon. In one case under observation for nine days the temperature did not exceed 100.8° until forty-eight hours before death, when it registered 102° .

As a whole the fatal cases showed a greater degree of cyanosis than was seen in the lobar type. The pulse-rates and the respiratory rates tended to be greater than in the cases having lobar pneumonia. The great depression of the majority of the patients from the beginning foretold a prognosis of a grave nature.

A characteristic sputum was produced in which, among other organisms, the bacillus of influenza was uniformly present. Grossly the sputum was pale green, purulent, nummular and at times was raised only after severe coughing. Cough was more frequent, severe and distressing than in the cases of lobar pneumonia. Signs of pleurisy were uncommon.

The total number of cases was 14; 11 died and 3 recovered. The average duration of the fatal cases was fifteen days; of those living, seventeen days. Other clinical facts to be noted were: The occurrence of laryngitis in 3 cases, pleural pain in 1 case and epistaxis in 1 case. At necropsy, dry adhesive pericarditis was found in 1 case, pleurisy in 2 cases and empyema in 1 case.

CASE HISTORIES. The protocols of 2 cases of lobar pneumonia and 2 cases of bronchopneumonia are given to illustrate in detail some of the differences already noted.

CASE I.—W. B., American soldier, aged twenty years, was admitted October 31, 1918, with a history of sudden onset, four days previously, of chilly sensations, headache and generalized aching pains, particularly in the right shoulder. On November 2 he was found to have consolidation of the right upper lobe and on the following day signs of the same process throughout the left lower lobe. He was then moderately cyanotic and dyspneic and raised sticky blood-stained sputum. On November 4 his chest showed marked dulness over the right back, increasing to flatness at the base where tactile fremitus was absent. There was very little movement of the right chest. Bronchial breathing was heard

over the upper lobe, but gradually decreased in intensity and became absent at the base. The left chest presented dulness from the midscapula to the base, bronchial breathing, increased voice sounds and some moist rales. The right chest was tapped in the posterior axillary line but only 1 cm. of bloody fluid was obtained, which, on culture, grew pneumococcus Type II. Blood culture was negative.

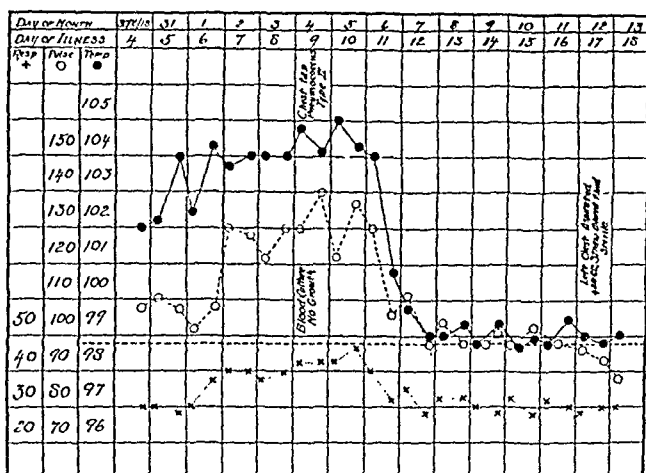


CHART I.

The temperature since October 30 had remained continuously between 103° and 105°; the pulse was usually 110 to 120 and respirations 30 to 45. On November 7 the general condition of the patient was greatly improved, the temperature having dropped to normal during the preceding thirty-six hours. There was less dulness at the right base. On November 8 he complained of pleural pain in the left chest, but no rub was heard. There was still frank consolidation of the left lower lobe. Throughout the right chest breathing was decreased and there were a few fine scattered moist rales. Fluoroscopy showed no evidence of fluid. By November 12 the right chest was rapidly clearing up. The left base however, was flat to the level of the scapular angle, with absent tactile fremitus and breath sounds. This base was tapped and 420 cm. of clear straw-colored fluid removed, which was sterile on culture. On November 15 the chest signs had disappeared except for some dulness and changed breathing at the left base, and the patient was in fine condition.

CASE II.—A. F. S., American soldier, aged twenty-six years, was admitted November 25, 1918. He had been ill for six days with headache and general malaise and had had a severe cold. Recently he had developed cough and pain in the right side of the chest. The chest examination was negative except for a few fine pleural rales at the right base. On the day after entry, however, there was moderate dulness over the right upper lobe posteriorly, with

increased vocal fremitus and bronchovesicular breathing. The left lung was clear. The sputum was blood-streaked. On the following day there was complete consolidation of the right lower lobe and signs of involvement of the lower one-third of the right upper lobe. There was some dulness over the left lower lobe but no change in the breath sounds. The sputum was sticky and rusty. The patient was cyanotic, but his condition was still good. Blood culture gave a positive growth of pneumococcus Type I. By November 29 there was intense bronchial breathing over the left base posteriorly and in the axilla. On the right the breath sounds came through less well. The sputum consisted chiefly of blood-streaked mucus. The temperature had been maintained at 103° or above. Cyanosis gradually increased, the pulse-rate and respiratory rate steadily mounted and the patient died December 2.

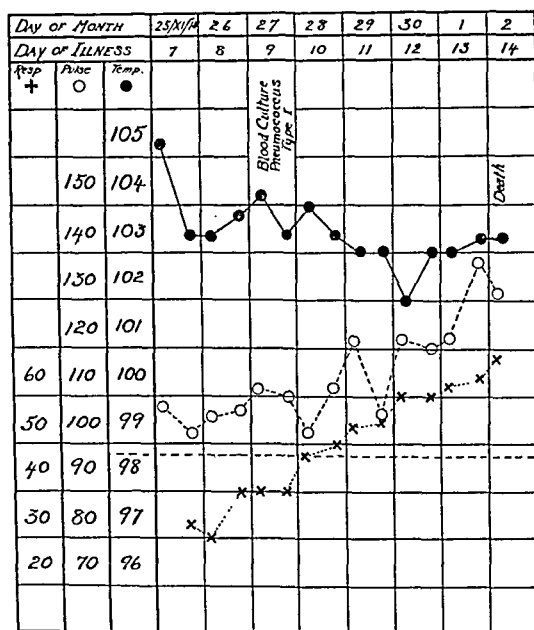


CHART II.

At necropsy a small amount of purulent fluid was found in the left pleural cavity, while in the right there was a moderate amount of more purulent fluid, with shaggy pleural exudate. The upper lobe of the right lung was completely consolidated; the cut surface was reddish-gray. The right lower lobe presented some edema and a considerable exudate of blood and fibrin. Sections of the tissue sank in water. The left lower lobe showed a generalized fibrinous pleurisy. There was complete consolidation, the cut surface being deep red in color. The upper lobe was edematous but presented no consolidation. Cultures from the lungs developed pneumococcus Type I.

CASE III.—T. F., British soldier, aged twenty-three years, was admitted November 10, 1918. He had been taken suddenly ill three days before with intense headache, generalized aching pains and hot and cold sensations. He had a little cough and complained of loss of appetite. His bowels were constipated.

At the right base posteriorly there was impaired resonance, with decreased breathing and scattered, moist rales were heard in both lungs. The patient was transferred to the isolation ward on November 20. His temperature had fluctuated daily from the date of entrance; the respirations had ranged from 24 to 36 and the pulse-rate from 90 to 100. The chest now showed moderate dulness at the right base posteriorly. There were numerous fine moist rales in both bases and on the right pleural rales were heard after cough. The sputum was light, greenish-yellow, airless pus, containing the bacillus of influenza and *Micrococcus catarrhalis*. A blood culture

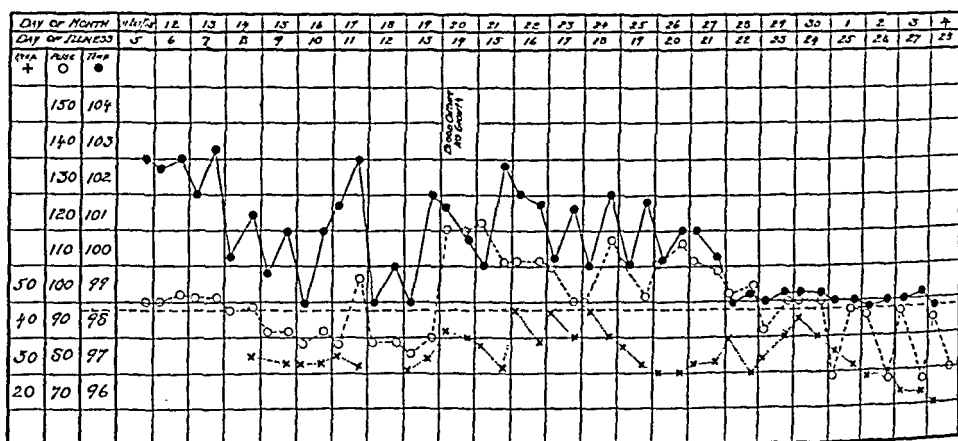


CHART III.

was negative. By November 25 the temperature was still fluctuating, but the general condition had improved. There was dulness on the right from the spine of the scapula to the base, with distant breathing and a few sticky, moist rales. Many similar rales were heard in the left lower lobe. On November 27 the left lung was clear, dulness on the right had increased and breath sounds at the base were faint. A chest tap proved negative. Fluoroscopy showed nothing remarkable on the left side, but on the right there was increased density, slight at the apex, increasing to the base, but not suggesting fluid. The diaphragmatic movements were restricted on both sides. On December 1 the lungs were clearing up and the patient was rapidly improving. The temperature had been normal since November 28.

CASE IV.—G. F. R., American soldier, aged twenty-eight years, was admitted November 6, 1918, with a diagnosis of gunshot wound of the right deltoid, from which the foreign body had been

removed at a casualty clearing station. The wound was in good condition. Four days after entry he was taken suddenly ill with fever, headache and pains across the chest. By November 14 he had developed a cough, coryza and mild laryngitis. The lungs were negative. A blood culture made November 15 was negative. On November 16 the patient was very cyanotic, had increased respirations and raised purulent sputum. The lungs showed no dulness anteriorly. Posteriorly there was impaired resonance over both sides, with diminished breathing and moist rales at both bases. There was no bronchial breathing. A second blood culture was negative. On November 17 there was bronchial breathing high in the left axilla and increased voice sounds. At the left base posteriorly there were many moist rales. On November 18 a third blood culture was negative. On November 19 the chest showed moderate general dulness over both sides posteriorly, more marked

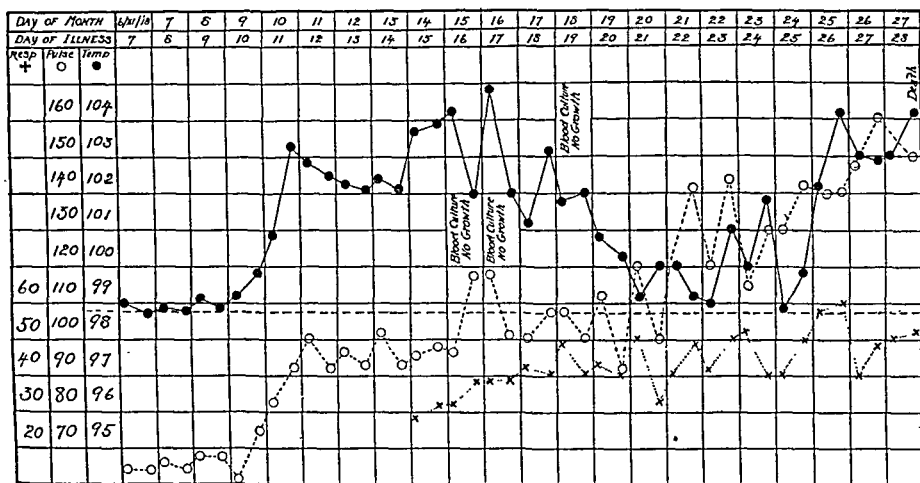


CHART IV.

on the left. There were moist rales from the apices to the bases, but no bronchial breathing. The sputum was grass-green-colored pus containing the bacillus of influenza. On November 20 the temperature recorded was normal, but the respirations were still 50 and pulse 120. The laryngitis had increased and the chest examination showed scattered moist rales but no bronchial breathing. By November 25 the man was extremely prostrated, very cyanotic, delirious and restless. There were signs of consolidation over the entire right lower lobe and bronchial breathing in the left axilla. Death occurred three days later.

Necropsy examination showed an extensive bronchopneumonia throughout both lungs. The lesions were numerous. The process apparently was many days old, since the areas immediately around the bronchioles were gray, but a more recent extension had effected almost complete consolidation in certain areas. There was no pleurisy.

CLINICAL SUMMARY. The cases of lobar pneumonia therefore were distinguished clinically from those having bronchopneumonia by the high even temperature curve, blood-tinged mucoid sputum, evidence of consolidation in one or more lobes early in the disease, pleurisy and by a shorter clinical course. The cases of bronchopneumonia showed fluctuating temperature curves produced a purulent sputum, developed indefinite or variable signs in the lungs, usually without pleurisy, and had a longer clinical course.

BACTERIOLOGY. The main bacteriological study of the cases was confined to blood cultures. The results are shown in Table I.

TABLE I.—BLOOD CULTURES IN REFERENCE TO DISEASE.

	Number positive.	Number negative.	Per cent. positive.	Per cent. negative.
Lobar pneumonia	13	9	59	41
Bronchopneumonia	0	11	0	100

It is noteworthy that 59 per cent. of 22 cases of lobar pneumonia had a septicemia in contrast to the negative findings in all of 11 cases of bronchopneumonia. This difference in the two types of cases is emphasized because it suggests a distinctive etiology for each type and confirms the clinical classification.

That the pneumococcus septicemia was not due to an agonal invasion of the blood stream is shown by the following facts: One positive culture was obtained fourteen hours before death, three were obtained twenty-four hours before death and the remainder between two and five days before death.

The types of pneumococcus which were found in blood cultures are shown in Table II.

TABLE II.—TYPE OF PNEUMOCOCCUS IN BLOOD CULTURES.

	Type I.	Type II.	Type IV.
Number of cases	1	11	1

In 7 additional cases of lobar pneumonia the type of pneumococcus was determined from the sputum by Avery's method or from cultures obtained by lung puncture. They showed 4 instances of pneumococcus Type II and 3 of pneumococcus Type IV. In 20 cases of lobar pneumonia, therefore, the types of pneumococcus obtained were: Type I, 1 case; Type II, 15 cases; Type IV, 4 cases. The high incidence of Type II is not explained.

In 14 cases of bronchopneumonia, on the other hand, cultures of the sputum contained pneumococcus only twice (pneumococcus Type I once and Type IV once), despite repeated attempts to grow the organism in other cases.

In this connection it should be mentioned that the bacillus of influenza was seen in films from the sputum of a few cases of the

lobar pneumonia group in addition to the pneumococcus. In the bronchopneumonia cases, however, the bacillus of influenza was always found in large numbers and the pneumococcus was either found rarely or not recognized at all.

MORTALITY STATISTICS. The total mortality of approximately 70 per cent. in each group shown in Table III indicates the severity of the pneumonia under consideration.

TABLE III.—MORTALITY WITH REFERENCE TO DISEASE.

	Living.		Dying.	
	Number.	Per cent.	Number.	Per cent.
Lobar pneumonia	8	32.0	17	68.0
Bronchopneumonia	4	28.5	10	71.5

This high rate for the series resulted in part from the plan of selecting the cases for isolation that were most gravely ill. Moreover, as the mortality in both types of pneumonia was nearly the same, these observations suggest that the primary epidemic disease preceding the pneumonia altered the threshold of resistance to any secondary invaders to a considerable degree.

TABLE IV.—MORTALITY WITH REFERENCE TO NATIONALITY.

	Lobar pneumonia.					Bronchopneumonia.				
	Total cases.	Living.	Per cent.	Dying.	Per cent.	Total cases.	Living.	Per cent.	Dying.	Per cent.
British . .	10	5	50	5	50	4	2	50	2	50
American .	15	3	20	12	80	10	2	20	8	80

Table IV shows that of the 14 British patients, 10, or 71.5 per cent., had lobar pneumonia, and 4, or 28.5 per cent., had bronchopneumonia. Of the 10 cases of lobar pneumonia 5 died, a mortality of 50 per cent.; and of the 4 cases of bronchopneumonia, 2 died, a mortality of 50 per cent. Of the 25 American patients, 15, or 60 per cent., had lobar pneumonia, and 10, or 40 per cent., had bronchopneumonia. Of the 15 patients having lobar pneumonia, 12 died, a mortality of 80 per cent., while of the 10 patients having bronchopneumonia, 8 died, a mortality of 80 per cent. In the total series, therefore, lobar pneumonia due to pneumococcus infection occurred with about the same frequency in both nationalities, while the mortality for both lobar and bronchopneumonia was 30 per cent. greater for the American patients than for the British.

The mortality in the cases of lobar pneumonia having positive and negative blood cultures is shown in Table V.

TABLE V.—MORTALITY WITH REFERENCE TO POSITIVE BLOOD CULTURES.

	Of cases with positive cultures.		Of cases with negative cultures.	
	Number.	Per cent.	Number.	Per cent.
Living	1	7.7	6	66
Dying	12	92.3	3	33

Of 13 cases with pneumococcus septicemia 12 died, while of 9 cases with negative blood cultures 6 survived. The fatal outcome of the cases having positive blood cultures, particularly pneumococcus Type II, is in accord with experiences of other observers.

PATHOLOGY. *Pathological Findings.* The gross appearance of the pneumonic lungs suggested a division into the following groups:

1. Pure bronchopneumonia: The lesions were discrete, even in an advanced stage. Between the lesions the lung tissue was emphysematous. Pleurisy was not often concurrent.

The individual lesion commonly began as a small hemorrhagic area about an inflamed bronchiole. As it grew in size fibrin was added and the lesion projected slightly above the surface, becoming easily palpable. The leukocytes increased and it became more gray. The final stage was from 1 to 2 mm. to 8 or 9 cm. in diameter, with a well-defined margin. The cut edges of the bronchi usually appeared thickened and projected sharply above the surface. Occasionally there was softening in the center of the nodule.

2. Rapidly Spreading Bronchopneumonia: The patches were large and ill-defined, often becoming confluent. In an early stage the lesion appeared as a large area having a dark red, "beefy" look, feeling smooth and non-granular. Even when the whole lobe was involved by the confluence of patches it did not have the massive appearance of a true lobar pneumonia, and a lumpy feeling was evident on palpation. Often small areas containing air or reddish fluid were found.

Usually there was no pleurisy in these cases. If present, it was without appreciable exudate. Two cases in our series were classified as of this type.

3. Pure Lobar Pneumonia: In these cases the lungs were atypical. They were large, massive and evenly firm on palpation. In distinction from the two previous types there was almost invariably a marked fibrinopurulent pleurisy over the affected lobe. This pleural lesion was lacking in the same case over lobes which were not involved in the lobar process, even though they presented marked bronchopneumonia.

The cut surface showed even consolidation, some in the stage of red hepatization, some in the gray stage.

4. In a certain number of cases the lobar pneumonias gave evidence of a previous bronchopneumonic process in the same lobe. Immediately about the bronchi there were areas showing older, harder lesions of a red or gray color.

5. In many cases the lobes not involved in the lobar process showed a bronchopneumonic process. It seemed probable that in some of these cases there was also a bronchopneumonic process in the lobe with lobar pneumonia, which was obscured by the lobar consolidation.

6. In 3 cases a lobe or lobes were edematous, with red fluid and airless, but not consolidated.

Associated Processes: Marked bronchitis was nearly always present. Pericarditis was noted in 3 cases. In 1 case it was of the dry adhesive type and concurrent with bronchopneumonia. In the 2 other cases it was purulent and associated with lobar pneumonia. The pericardial exudate contained a pure culture of pneumococcus in each of the 2 latter cases. In 1 case the pneumococcus on being typed proved to be Type II, which was the same as in the blood culture and lung culture.

Empyema: In 4 cases empyema occurred with lobar pneumonia, in 1 case with bronchopneumonia. Marked collapse occurred only in the bronchopneumonic case.

Pleural Exudate: In 6 cases, all lobar pneumonia, there was excess of pleural fluid, slightly cloudy and reddish brown.

SUMMARY. 1. A series of 39 cases of pneumonia complicating "influenza" is reported, in which lobar pneumonia occurred in 25, or 64 per cent., and bronchopneumonia in 14, or 36 per cent. The cases were selected, on account of their apparent severity, from many cases that were admitted to the hospital at the same time.

2. The cases of lobar pneumonia were characterized by lung signs typical of consolidation, high sustained temperature curves, blood-tinged mucoid sputum and a shorter course than the cases of bronchopneumonia.

3. The cases of bronchopneumonia showed indefinite and variable lung signs, fluctuating temperature curves, purulent sputum and tended to run a more prolonged course.

4. The total mortality of 70 per cent. was the same in both types of pneumonia, but was 30 per cent. higher for the American patients than for the British.

5. Positive blood cultures were obtained in 13 of 22 cases, 59 per cent., of lobar pneumonia. No organism except the pneumococcus was recovered, Type II occurring in 84.6 per cent. of the cases. The sputum in the cases examined microscopically contained pneumococcus, usually in large numbers, while in a few cases the bacillus of influenza was also found.

6. No positive blood cultures were obtained in 11 of 14 cases of bronchopneumonia. The sputum always contained the bacillus of

influenza in large numbers, although a few contained the pneumococcus as well.

7. The pathological picture at necropsy, in general, was that typical of lobar pneumonia in some cases, bronchopneumonia in others and combinations of both types in a few cases.

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REVIEWS

RULES FOR RECOVERY FROM TUBERCULOSIS. By LAWRASON BROWN, M.D. Third edition. Pp. 192. Philadelphia and New York: Lea & Febiger, 1919.

THIS book is composed of a series of short essays or papers, twenty-four in number, each dealing with an independent phase of the disease and its treatment as viewed from the patient's standpoint. Such subjects as rest, diet, climate, clothing, habits, means of infection, choice of room, with the utilization of the porch and recreation for the tuberculous patients, are taken up and described in sufficient detail to satisfy the great majority of patients' thirst for knowledge. The book was primarily written for the use of patients, but it contains so many good, practical points in the treatment of the disease, the relation of patient to physician, what the patient may do without consulting the physician, all alarming symptoms, that no physician can afford not to utilize it to the greatest extent both as for himself and for his patient. It is a book which could well be adopted by the public as a big tool in the fight against this disease. It is written in an interesting style, concise and very practical. All tuberculous patients would find it of great help in deciding many simple questions which arise daily while taking the "cure" and after their return to civilian life.

T. K.

THE MEDICAL CLINICS OF NORTH AMERICA. Volume II, Number 5, Boston No. Pp. 324; 34 illustrations and 12 diagrams. Philadelphia and London: W. B. Saunders Company, March, 1919.

THIS volume contains many interesting and instructive articles. The first comprises a series of clinics, by Dr. Henry A. Christian, upon "Cutaneous Pigmentation, Jaundice, Palpable Liver and Spleen and Ascites." Dr. Christian considers all facts with the student, and finally reaches his diagnosis by exclusion. He reviews briefly the literature upon hemochromatosis and bronze diabetes, pointing out many of the recent studies in hemochromatosis from the etiological standpoint, all of which remains somewhat a factor of doubt. The results of his case are confirmed by a postmortem

report. He also reports a case of fibrinous bronchitis, with again a brief review of the literature. He points out the great importance of a closer macroscopic study of the sputum and a gradual tendency of all men to look for everything with the microscope and not with the naked eye. The etiological factors, methods of diagnosis and finally the importance of vaccine therapy in such cases, as well as in chronic bronchitis and asthma, are considered. Dr. George R. Minot reports 4 cases of enlarged spleen, 2 of which were Banti's disease and the others a myelogenous leukemia. In the former a very brief, concise description is given, dividing the disease into its three stages and pointing out especially its chronicity. The diagnostic points are mentioned, with special reference to the blood-making organs. The differential diagnosis between this disease and Gaucher's disease, von Jaksch's anemia, hemolytic jaundice, splenic thrombosis and syphilis of the spleen is given. He advocates early splenectomy in Banti's disease. The second case gave symptoms suggestive of a peptic ulcer, and, in fact, had been previously operated upon for that disease. Radium and roentgen rays are advocated early in the treatment of myelogenous leukemia. Dr. John B. Hawes calls attention to the fact that the recent epidemic of influenza has not caused an increase of activity in a large proportion of healed or inactive cases of pulmonary tuberculosis. He shows statistics to prove that the death-rate and incidence of influenza among inactive and active tuberculous patients were not as high as in the non-pulmonary cases. He thinks that these tuberculous cases have a certain degree of immunity to influenza. He calls attention to the increase in difficulty in the diagnosis of pulmonary tuberculosis, owing to this respiratory epidemic, and warns against making a diagnosis upon insufficient clinical manifestations when there is a recent history of influenza, as a great many of the lung findings soon clear up without doing any permanent damage. Dr. Frederick T. Lord reports a case of pulmonary abscess, unknown etiology, operation and recovery. Dr. Franklin W. White's article upon "The Improvement in the Medical Treatment of Chronic Ulcer of the Stomach and Duodenum" needs special mention. He emphasizes the importance of individualizing the treatment of every case. His follow-up system, using the roentgen rays to study the ulcer anatomically, as well as the motility of the stomach, associated with the general condition of the patient, seems to be the best way of formulating an opinion as to the direct progress of all ulcer cases. The diagrams showing improvement in duodenal cap deformity with marked clinical improvement are very interesting. In an article upon "Lessons of the War in the Field of Cardiac Disease," Dr. F. W. Peabody calls attention to three distinct types of heart disease, which have a large bearing upon civilian cases. He calls attention especially to the functional cardiac or effort syndrome cases—cases with definite endocardial lesions without any clinical

manifestations, and lastly cases with systolic apical murmurs without evidence of any cardiac hypertrophy. These cases, however, have a definite history of severe attacks of tonsillitis or acute rheumatic fever. He believes these are cases of early organic heart disease, and the method of treatment is directed toward cleaning up all focal infections.

T. K.

THE MEDICAL CLINICS OF NORTH AMERICA. Volume II, Number 6, Baltimore No. Pp. 297; 7 illustrations. Philadelphia and London: W. B. Saunders Company, May, 1919.

DR. LEWELLYS F. BARKER reports a case of funicular myelitis with an early blood picture of only a secondary anemia. He points out the frequent nervous lesions associated with the anemias. A careful differential diagnosis between parasyphilis, multiple sclerosis and transverse myelitis is considered. The etiology and pathology with reference to the recent literature is also added. Dr. Julius Friedenwald gives his personal experiences in the treatment of ulcer of the stomach. He gives a brief review of the various medical treatments used in peptic ulcer, including the Leube cure; the Lenhartz cure; the Sippy cure; comparative results of the various forms of treatment; Einhorn's duodenal alimentation; brief discussion of the surgical treatment. The advantage of pyloroplasty over gastro-enterostomy, as compared upon a similar 100 cases, is given with from 8 to 11 per cent. better immediate and final results in favor of the pyloroplasty. Medically, the Sippy cure has been the one adopted in his clinic. It is described somewhat in detail. The follow-up system with the roentgen-ray studies is called attention to as the only sure way of judging the healing process of the ulcer. A diet list used following the ulcer treatment as well as the one comprising the actual treatment is appended. In another short article he reports 41 cases of true achylia gastrica and 37 spurious achylas as determined by the fractional method. Some of the true achylas occurred in chronic gastritis, gastric ulcer, gastric carcinoma, pernicious anemia, cholelithiasis, syphilis of the stomach, pulmonary tuberculosis, and, after an operation, where a pylorectomy and gastro-enterostomy had been done. He contrasts the low total acid, free HCl curve with the hypermotility in the true achylas and that of the chronic gastritis cases wherein which the total acid curve is higher, associated with a large quantity of mucus and oftentimes a delayed motility. Dr. Gordon Wilson lays special stress upon the necessity of convincing one's patient that he has the disease in the treatment of pulmonary tuberculosis. Thinking that this is the first fundamental and to help the patient to realize that tuberculosis is essentially a chronic disease, passing through periods of apparent

quiescence without symptoms. The remainder of the treatment must be entirely individualized according to the patient's means, social status, etc. The climate will not cure the disease, but the life which the patient leads in that climate is the most important.

Pneumococcus sepsis in contradistinction to local and focal infection, with full discussion of symptoms, prognosis and treatment, is described by Dr. Paul W. Clough. He believes that more urgent search for positive blood cultures in pneumonia is needed. He also thinks that the cases which get well give a positive culture early, later becoming sterile, while in the malignant cases the opposite is true. Blood cultures showing more than 5 colonies to the cubic centimeter of blood gives a less favorable prognosis. The method of invasion of the blood stream is described. Serum treatment in large doses in Type I infections only is advocated. The literature on the subject is partially reviewed. Gastro-intestinal disturbances in metabolic diseases and diseases of the ductless glands are set forth by Dr. John H. King. The role of diet in the treatment of digestive disorders, with a description of irritation and non-irritating foods as used in various disorders, is given in detail by Dr. E. H. Gaither. Dr. Louis Hamman describes diabetes with reference to the latest literature and complete physiological processes.

T. K.

SURGICAL TREATMENT. By JAMES PETER WARBASE, Surgeon to the Wyckoff Heights Hospital, Brooklyn, New York. Volume III. Pp. 861; 865 illustrations. Philadelphia and London: W. B. Saunders Company, 1919.

IN this third and final volume the author maintains the standard set in its predecessors. It continues abdominal surgery through herniæ, affections of the liver and gall-bladder, male genito-urinary and female genital organs. The affections of the upper and lower extremities, not included in the other two volumes, plastic and cosmetic surgery and some phases of surgery not previously considered, complete the volume. Among the last a chapter on electricity and radiation and another on the economics of surgical treatment deserve special attention. An appendix of twenty pages was apparently added to include material after the chapter to which it properly belongs had been completed and gone to print, indicating the desire of the author to include all available valuable new facts.

A survey of the three volumes impresses one with their general excellence. The dominating feature seems to lie in the number and quality of its illustrations, and the greatest value of these is seen in the diagrammatic simplicity with which the essential phases are emphasized. As to the frequency with which they are employed it is not uncommon to find two and three on one page and some-

times five. The relative frequency of illustrations to text increases with each succeeding volume. For a total of 2508 pages of text in the three volumes there are 2324 illustrations, all of high-grade excellence. While the text is absolutely necessary to a book and the illustrations are not, yet the greatest modern need is more good illustrations.

The great fault of the old text-book and later the system was that the subject was too big for the space allowed, so that the active surgeon did not find his particular need in an emergency supplied or not with sufficient detail. The exclusion of almost all except therapeutics is an important step in the direction of overcoming this defect in the field in which the immediate demand for special surgical knowledge is most frequent. Thus we find 42 pages devoted to the treatment of affections of the rectum and anus and 184 pages to that of the male genito-urinary organs, the tendency being toward the special treatise or monograph type of treatment of each surgical field.

✓ This one-man system has fully justified and made a place for itself among the standard works on general surgery. The long accepted method of assigning each of the various parts to an expert in that particular field of surgery is here set aside for one in which an expert selects from the literature the best in every field and resets it in easily digestible form for our ready use. It has already proved its value by the popularity it has won by its first two volumes.

THE BLIND: THEIR CONDITION AND THE WORK BEING DONE FOR THEM IN THE UNITED STATES. By HARRY BEST, Ph.D. Pp. 763. New York: The Macmillan Company.

THOSE who are familiar with the author's book on *The Deaf* need no description of his thoroughness and well-founded deductions. The present volume is essentially a book of reference on conditions of the blind in the United States. The first part takes up the general condition of the blind, their health, their legal treatment and economic condition and the cost of blindness to the individual and the State. The importance of the subject to the State seems apparent when the total cost of the blind in the United States is realized to be nearly \$31,000,000.

The second part of the book considers the possibilities of the prevention of blindness due to heredity, to disease and to accident. The statement is made that, on the whole, blindness is decreasing somewhat and that a still further decrease should follow.

The third part is concerned with the education of blind children. It is largely historical. Then follow chapters dealing with intellectual provision for the adult blind and material provision for the blind, their work in the industries and the attitude of Workmen

Compensation laws toward the blind. Further chapters deal with organizations interested in the blind and provisions of the National Government for persons blinded in war.

The work is encyclopedic in character and the author is to be praised for compiling in one volume so much valuable data. The book will prove invaluable to anyone at all interested in the blind.

C. N. S.

PYE'S SURGICAL HANDICRAFT. By W. H. CLAYTON-GREENE, B.A., M.B., B.C. (Camb.), F.R.C.S. (Eng.); Surgeon to St. Mary's Hospital. Eighth edition. Pp. 639; 362 illustrations and 11 plates. New York: William Wood & Co., 1919.

WALTER PYE wrote the first edition of this book thirty-five years ago, describing "the details of surgical work as it appears from the point of view of house surgeons and dressers in surgical wards." In this the eighth edition it has been fully revised and new illustrations and text have been added. Some chapters have been rewritten, particularly the one treating of war wounds and the control of sepsis. The author has been guided by the works of Sir Robert Jones in advising treatment of orthopedic cases. In addition to measures applicable in general surgical cases, there are chapters devoted to the surgical specialties written by specialists. Among the miscellaneous subjects included in the work are a brief but excellent chapter on the treatment of the teeth, treatment of poisoning, of drowning, and the use of the roentgen-rays. The newer methods of treatment that properly belong within the scope of the book are included in this edition, but here where detail is needed it is somewhat lacking.

G. M. L.

OUTLINE OF GENITO-URINARY SURGERY. By GEORGE GILBERT SMITH, M.D., Genito-urinary Surgeon to Out-Patients, Massachusetts General Hospital; Member of American Association of Genito-urinary Surgeons and the American Urological Association, etc. Pp. 300; 74 illustrations. Philadelphia and London: W. B. Saunders Company, 1919.

THIS work is one that should appeal strongly to the general practitioner, in that it draws a sharp dividing line between the diagnostic work which can be done by the general practitioner and that which must be referred to the urologist.

The text is well written and all superfluous description is wisely eliminated. The statements of the author are those which have their foundation in practical experience. At the end of each chapter a bibliography of the more important articles is appended.

The diseases of the male genitalia and urinary organs are discussed in a systematic way and in as complete a manner as possible within the scope of the work.

The chapters devoted to the diseases of the bladder and kidney are particularly good, in that attention is directed to the serious significance of the symptoms hematuria and pyuria and the necessity of determining accurately and quickly the underlying pathology.

W. H. M.

TRANSACTIONS OF THE SECTION ON GENITO-URINARY DISEASES OF THE AMERICAN MEDICAL ASSOCIATION. Sixty-ninth Annual Session, June, 1918. Pp. 300; illustrated. Chicago: Am. Med. Assn. Press, 1918.

THE volume is reprinted from the *Journal of the American Medical Association*, and includes a list of officers of the Section, the Proceedings of the Section and the papers presented, together with abstracts of the discussion. The illustrations are particularly well reproduced. The papers, seventeen in all, characterize the advancing scientific spirit of modern urology.

G. M. L.

TRANSACTIONS OF THE ASSOCIATION OF AMERICAN PHYSICIANS. Thirty-third Session, May 7 and 8, 1918. Vol. XXXIII.

THE transactions of such a notable body of physicians are always held in great respect, and the review of papers read at their sessions is a privilege. The present volume contains thirty-six papers on as many different subjects, including the address of the President, Dr. Francis H. Williams, on the "Importance of Bedside Instruction in the Teaching of Therapeutics." To select among the other papers those deserving special mention is obviously unfair, because what would appeal to one reviewer possibly would not to another. Nevertheless, of unusual interest are the following papers: "Results from the Intravenous Use of Salvarsan in Syphilis of the Nervous System," by B. Sachs, M.D.; "Acute Pancreatitis in Typhoid Fever," by Thomas McCrae, M.D.; "The Intravenous Serum Treatment of Epidemic Cerebrospinal Meningitis," by W. W. Herrick, M.D.; the "Rat and Infantile Paralysis: a Theory," by Mark W. Richardson, M.D.; "A Case of Bulimia," by George Dock, M.D.; "Pneumonia at a Base Hospital," by Rufus Cole, M.D., and W. G. MacCallum, M.D.; "The Thyroid Hormone and its Relation to Metabolism," by E. C. Kendall, Ph.D.; "Chronic Septicemic Endocarditis, with Splenomegaly: Treatment by Splenectomy," by David Riesman, M.D.

C. N. S.

PROGRESS OF MEDICAL SCIENCE

MEDICINE

UNDER THE CHARGE OF

W. S. THAYER, M.D.,

PROFESSOR OF CLINICAL MEDICINE, JOHNS HOPKINS UNIVERSITY, BALTIMORE,
MARYLAND,

ROGER S. MORRIS, M.D.,

FREDERICK FORCHHEIMER PROFESSOR OF MEDICINE IN THE UNIVERSITY OF
CINCINNATI, CINCINNATI, OHIO,

AND

THOMAS ORDWAY, M.D.,

DEAN OF UNION UNIVERSITY (MEDICAL DEPARTMENT), ALBANY, N. Y.

The Gastric Response to Foods. II. A Fractional Study of the Coagulation of Milk in the Human Stomach.—For their experiments, BERGEIM, EVVARD et al. (*Am. Jour. Physiol.*, 1919, xlviii, 411) were fortunate enough to secure the services of a man who could regurgitate the contents of his stomach at will at any desired stage of digestion. Two kinds of studies were made: one in which small samples of the stomach contents were regurgitated at intervals throughout the curdling period of the milk, the other in which the stomach was completely emptied half an hour after the ingestion of a pint of milk. The experiments were usually made before breakfast on an empty stomach. The following is a brief summary of their findings: Milk drunk rapidly (500 c.c. in ten to thirty seconds) left the stomach more rapidly and produced a smaller curd mass than milk drunk slowly (five to ten minutes). Curding took place very rapidly in the stomach, irrespective of temperature; there was a slight slowing in the coagulation rate when the milk was considerably below body temperature. Raw whole milk formed firm, "rubbery," white curds, the maximum formation taking place about one hour after drinking. Milk which had been boiled five minutes gave small, soft, yellow curds, which left the stomach more rapidly and were much more digestible than the tough curds resulting from raw milk. Previous experiments have shown that the boiling of milk for five minutes does not materially alter its nutritive value or growth-promoting properties, but may lower its antiscorbutic value. Pasteurization was not as effective as boiling, but the curds were smaller

than from whole raw milk. A mixture of 80 per cent. boiled whole milk and 20 per cent. raw whole milk gave curds very similar to those of straight raw, whole milk. Raw skimmed milk formed particularly tough, hard curds. These formed very quickly (one-half minute) and within five minutes coalesced into masses as large as a man's thumb. They were difficult to regurgitate and the regurgitator complained of a "heavy" feeling in the stomach. When the skimmed milk was boiled the curds were smaller and softer than those of the raw skimmed milk, but not as small and soft as those of the boiled whole milk. As the skimmed milk is relatively poor in fat it is apparent that the fat content is an important factor in determining the character of the curd. The higher the fat concentration in the milk used the smaller and softer the curds and the longer it remained in the stomach. Two and a half hours after the ingestion of a pint of 40 per cent. cream, 475 c.c. were regurgitated. This rich cream caused a heavy, uncomfortable feeling in the stomach of the subject. The drinking of water before the ingestion of the milk had no material effect except that the curds were somewhat softer. The addition of sodium bicarbonate caused the formation of smaller and softer curds than those produced in similar milk without bicarbonate. There was definite curd formation in five minutes, although the stomach contents remained alkaline for thirty minutes. The bicarbonate was not as effective as boiling in producing small, soft curds.

Observations on Hyperglycemia and Glycosuria.—In his Croomian Lecture, HAMBURGER (*British Med. Jour.*, March 8, 1919, p. 267) gives his answer to two questions which have long puzzled the pathologist and the clinician: (1) Why does sugar, which is always present in the blood, rarely if ever appear in the urine of normal individuals, and (2) why does sugar appear in the urine when its presence in the blood exceeds a certain limit? Hamburger discards as untenable all the theories which have been offered to explain glycosuria except that of Lepine, who believes that sugar is present in the plasma as a colloidal compound—a compound of non-colloidal glucose with a substance present in the plasma. The glomerular epithelium is not permeable to this colloidal compound, but if the quantity of glucose becomes so great that the amount of the other substance is insufficient to bind it all, free glucose will circulate in the blood plasma, pass through the glomerular epithelium and appear in the urine. Hamburger's first task, in attempting to prove Lepine's theory, was to determine whether or not the kidney allowed free glucose to pass through. He selected frogs for his experimental animals, for in these it is possible to perfuse only the glomeruli. For the perfusion he used Ringer's solution, containing NaCl (0.7 per cent.), NaHCO₃ (0.02 per cent.), KCl (0.01 per cent.), CaCl (0.0075 per cent.). To this he added definite amounts of sugar. From his experiments he concludes that the glomerular membrane has the power of retaining free glucose, and this power is governed by the chemical composition of the perfusion fluid. When Ringer's solution containing 0.1 per cent. glucose is perfused through the kidney a "urine" containing 0.07 per cent. sugar is excreted and 0.03 per cent. is retained. If the percentage of KCl or CaCl₂ be changed in either direction the glomerular epithelium allows all the sugar to pass and none is retained.

However, by varying the quantities of potassium and calcium a point is reached at which they "balance" each other and the retentive power of the kidney is restored. If the concentration of NaHCO_3 in the Ringer's solution be raised from 0.02 per cent. to 0.285 per cent. (the quantity actually present in frog's serum) then the kidney retains more than 0.03 per cent., and the "urine" becomes wholly sugar-free. These results are of great importance, for they indicate that the urine of normal individuals is kept free from sugar by a nicely regulated permeability of the renal cells and not by a colloidal binding of the blood sugar. When fructose or lactose and dextrose occur in the perfusion fluid only the fructose or the lactose is let through. The sugars are separated as by a filter. This is a new form of permeability, where cells under physiological conditions though permeable to salts are yet impermeable to glucose, which like these is also a crystalloid. The size of the molecule is not the cause of this, as lactose, which possesses a much larger molecule than dextrose, passes through the glomerular membrane; it appears, therefore, that the structure of the glucose molecule must be considered responsible. This is interesting as a physiological illustration of the doctrine of stereo-isomerism. Hamburger's experiments throw light on the customary measures used in the treatment of advanced diabetes. In acidosis the alkali and the concentration of HCO_3 ions in the blood are diminished. In other words the concentration of NaHCO_3 in the blood has become smaller and the human kidney is in the same condition as the frog's kidney, through which a liquid which contains too little NaHCO_3 is perfused, and, like the latter, is unable to hold back all the sugar. Furthermore, in diabetes the quantity of K in the urine is greater than in normal persons. This loss of K by the blood plasma must be restored, for unless the concentration of NaHCO_3 is normal (0.285 per cent.) the concentration of K may not vary between wide limits without increasing the permeability of the kidney to sugar. Hamburger suggests that it would be well to give diabetic patients some KHCO_3 in addition to the customary NaHCO_3 . The oatmeal cure and the potato cure may owe their efficacy in part to the relatively large amounts of K which are found in these foods. The following hypothesis is offered to explain the relation between hyperglycemia and glycosuria: As long as the concentration of NaHCO_3 in the blood plasma is normal, even a moderate hyperglycemia will cause no glycosuria. If, however, the NaHCO_3 concentration is diminished the glomerular epithelium becomes sensitive to the proportions of Ca and K in the blood plasma and glycosuria occurs. A deficiency in the K must be met artificially, but the excretion of sugar can be prevented to a large extent by increasing the concentration of the NaHCO_3 .

Studies in the Mechanism of Absorption from the Intestine.—
I. The Colon. A Contribution to the One-sided Permeability of the Intestinal Wall to Chlorides. GOLDSCHMIDT and DAYTON (*Am. Jour. Physiol.*, 1919, xlviii, No. 4) conclude that the colon is not characterized by a one-sided permeability, for when distilled water or very dilute solutions of sodium chloride are introduced into the large intestine, chlorides diffuse from the blood into the intestinal contents. *II. The Colon. On the Passage of Fluid in Two Directions through the*

Intestinal Wall. When hypertonic solutions of sodium chloride are introduced into the colon they attract fluid into the intestine and at the same time chlorides pass into the blood. *III. The Colon. The Osmotic Pressure Equilibrium between the Intestinal Contents and the Blood.* Hypertonic and hypotonic solutions of sodium chloride come into partial pressure equilibrium with the blood and there appears to be an attempt at total osmotic pressure equilibrium between the colon contents and the blood. *IV. The Colon. The Behavior of Sodium and Magnesium Sulphate Solutions.* When hypotonic solutions of sodium sulphate are introduced into the colon, water is absorbed until the contents become nearly iso-osmotic with the blood. Hypertonic solutions attract water and the volume increases while the concentration decreases and becomes nearly isotonic with the blood. Solutions nearly iso-osmotic with the blood show little change in volume. There is therefore free passage of water with practically no diffusion (absorption) of sulphate, and the colon behaves toward solutions of sodium sulphate essentially like a semipermeable membrane. Magnesium sulphate shows even less absorption than sodium sulphate. The non-absorption of these salts from the colon emphasizes the important role played by the large intestine in saline catharsis. Providing the cathartic salt reaches the colon in sufficient amount, so that by osmotic interchange between the blood and colon enough fluid is introduced to increase the bulk and fluidity of the colon contents, catharsis will be assured. This might occur independent of the volume of fluid reaching the colon from the small intestine. The determining factor will be the amount of the salt which reaches the large intestine, and inasmuch as little is absorbed, this will be cumulative. Furthermore, once enough of an isotonic or hypertonic solution has reached the large intestine to increase the bulk and fluidity of the colon contents, catharsis is assured, as they have shown that but a small quantity of the salt is absorbed in ten hours.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Hypophyseal Dystrophy in Hydrocephalus.—STRAUCH (*Jour. Am. Med. Assn.*, June 14, 1919, No. 24, vol. lxxii) reports a case. Certain features of the history of this case suggest a part of the clinical picture of hypophyseal dystrophy. These manifestations must be distinguished from those of internal hydrocephalus. The rapid development of a deposit with eunuchoid localizations, and the high tolerance for glucose indicated constitutional metabolic changes such as are observed in functional deficiency of the posterior lobe of the hypophysis. The delicate skin, the lack of perspiration and the arterial hypertension pointed to this organ. On the other hand the abnormal increase of the size of the skull, with thinning of the region of the anterior fontanelle,

and the marked remissions and exacerbations of the nervous disturbances left no doubt about the existence of hydrocephalus internus. Its causative agent could not be ascertained clinically beyond dispute. The differential diagnosis considered an "idiopathic" hydrocephalus, or rather the exacerbation of a previous hydrocephalus ventriculorum and a possible distant obstructive lesion without focal manifestations. The presence of the hydrocephalus gave satisfactory explanation of dystrophy, through the assumption of a pressure lesion of the hypophyseal apparatus, and with the absence of optic nerve disturbance, even as late as the time of admission, militated against the assumption of a tumor of the hypophysis itself. The radiological findings were in accord with this, the shallow dish-like dilatation of the entrance of the sella turcica having been merely a partial manifestation of the cranial changes that were due to general increased intracranial tension. Polyuria and polydipsia, which were so marked in this case, have not been infrequently noted by other authors as a temporary symptom in hypophyseal dystrophy, and in a few cases a serious diabetes insipidus was a predominant feature. It has also been encountered for a period as an after-effect of surgical operations in the hypophyseal region, even of simple sellar decompression. The occurrence of polyuria in bloodless, mechanical or chemical irritations of the hypophysis, and the well-established fact of the diuretic effect of the extract of the nervous lobe, combine to indicate the cause of this clinical symptom to be an increased secretion, resulting from irritative conditions such as pressure, inflammation and the like. The state of initial stimulation of the posterior lobe in this case may be assumed to be preceding its irritation or destruction. The persistence of polydipsia during the period of well-developed adiposity, the latter indicative of hypofunction, cannot be explained on a different basis. It may be considered a habit formed during the illness. Several circumstances indicate this; the excessive drinking of water had entirely lost its initial compelling character and its degree; it became easily controlled by persuasion, was subject to occasion and absent during the stay in the hospital. On the other hand marked polyuria has been observed also in tumors (gumma) in the vicinity of the hypophysis, and in various affections of the brain stem (chiasma, thalamic region, etc.); it likewise has been produced by irritation of certain parts of the medulla oblongata. The polyphagia repeatedly mentioned in the literature has been attributed to posterior lobe insufficiency. If the rapid growth of the patient, the advanced development of the labia majora, and the growth of hair on the labia majora is interpreted in the light of present preponderant evidence of the function of the parts of the hypophysis, there may be possibly here an example of activation and hyperfunction of the anterior lobe, combined with posterior lobe insufficiency. The disturbance of micturition and defecation is only explained in the large hydrocephalic effusion, with pressure lesion of the corresponding cerebral districts.

Bacillus Tuberculosis in the Tonsils of Children Clinically Non-tuberculous. — AUSTIN (*Am. Jour. Dis. Children*, July, 1919, No. 1, vol. xviii) reviews the literature, which shows little written on the subject. Latham reported 45 cases, 7 of which showed tuberculosis. Friedman reported 147 cases with 17 showing tuberculosis. Kingsford

reported 17 cases with 7 cases of tuberculosis. Hess reported 13 cases with 1 case of tuberculosis. Mitchell reported 100 cases in which the tonsils were removed at operation from patients with tuberculous cervical glands; 44 of these had tuberculosis of the tonsils. He also reported 100 cases without signs of tuberculosis, in which examination of the tonsil showed 13 cases positive for tuberculosis. Austin began his work by developing a method of inoculating guinea-pigs with tonsillar tissue, which would not produce a high mortality, and would not involve destruction of the tubercle bacillus. The tonsils were removed from five healthy children and on removal were placed in sterile test-tubes. They were then washed thoroughly and placed in a sterile glass mortar, and minced into fine pieces with pointed scissors. Then the material was ground with a glass pestle, observing all the while aseptic precautions. A small amount of physiological sodium chloride solution was found to facilitate the grinding. The ground material after being thoroughly mixed was divided into two parts. To one was added a small amount of growth from a culture of tubercle bacillus, which was mixed in thoroughly. Each of the two parts was next mixed with its volume of antiformin, and placed in a centrifuge tube in the incubator at 37° C. for three hours or less. The antiformin was removed by successive washings in the centrifuge. About 1.5 c.c. were injected into the crushed lymph glands in the left groin of guinea-pigs of about 300 grams weight. Of the guinea-pigs injected with the material to which no culture of tubercle bacillus has been added all but one lived for seven weeks. They were then killed and no evidence of tuberculosis was found at autopsy. Of the animal receiving material to which culture of tubercle bacillus had been added, all but one developed firm large glands in the left groin in from two to five weeks. They were killed and revealed tuberculous lesions in these glands, in the spleen in the liver and elsewhere. This method was then applied to the excised tonsils of forty-five children. Fifteen were from two and a half years and thirty from five to twelve years of age. All were well developed and nourished. There was no personal history of tuberculosis. Cervical lymph glands were enlarged in twenty-one. In none was there any evidence of tuberculosis on physical examination. Only one of this series gave a positive test for tuberculosis, and this was of the human type. This case had no family history of tuberculosis, although two other cases had a history of tuberculosis in their families. The author states that although tuberculosis of the tonsils in children is not rare, most of the cases occur where there are tuberculous lesions elsewhere in the body, especially in the cervical lymph glands.

Antiscorbutic Properties of Fruits (an Experimental Study of Dried Orange Juice).—GIVENS and McCLUGAGE (*Am. Jour. Dis. Children*, July 19, 1919, No. 1, vol. xviii) previously reported the persistence of the antiscorbutic value of dried cabbages and tomatoes. Orange juice was dried by two methods and both products were fed to healthy guinea-pigs. They show this animal scurvy just as the human does, and is especially adapted for the experimental study of the antiscorbutic vitamin. In these experiments it was shown that experimental scurvy could be averted or cured by the use of a small amount of orange juice. Orange juice can be dried so that it retains a con-

siderable amount of antiscorbutic vitamin. The best method of drying is the one in which the temperature of drying is not unduly high, and the duration of the drying is very short. Orange juice stored for three months was active. The authors suggest the value of this antiscorbutic product where the price of the fresh fruit is prohibitive or where it is not to be had as among the poor of our cities. In addition there is a definite value on polar expeditions, in the navy and in the army during war.

The Acidotic State of Normal Newborns.—SEHAM (*Am. Jour. Dis. Children*, July, 1919, No. 1, vol. xviii) made 150 determinations on 50 babies whose ages ranged from one hour to thirty-two weeks. He studied among other things the effect of food and exercise upon the observations. He found that alveolar carbon dioxide tension is a practical index of acidosis. Fifty cubic centimeters of air in the bag over a period of thirty seconds for breathings gave the most constant results. The modification of the Plesch-Higgins method of collecting air with the use of the pulmotor mask is the most practical way of collecting air from newborn babies. He was not able to establish a lower carbon dioxide tension, which is indicative of the so-called "acidotic state." The ingestion of food and starvation and muscular exercise under these conditions had not demonstrable effect in the alveolar carbon dioxide tension. The urine of the normal newborn infant is nearly always acid. It takes on the average 1.7 gm. of sodium bicarbonate to turn the urine from acid to alkaline, giving 0.16 gm. every two hours by mouth. His results with the alkali tolerance test for normal newborn babies do not indicate an acidosis. He found that practically no acetone is found in the urine of normal newborns.

Protein Milk Powder.—BROWN and MACLACHLAN (*Am. Jour. Dis. Children*) give the results of their observation. It is indicated in severe cases of diarrhea, which do not respond to the elimination of carbohydrate in the usual milk mixture, and also in practically all cases of intoxication, and infectious diarrhea, and in many cases of dyspepsia in breast-fed infants. It was also found to be very useful in chronic intestinal indigestion in older children. Last but not least is its employment most essential in the preliminary corrective stage of atrophy or marasmus. It is used for three or four weeks and the authors were able to keep children on protein milk, or protein milk and starch or dextrimaltose for several months with substantial gain in weight and general development. To make protein milk a quart of certified raw milk is used. To this is added two teaspoonfuls of essence of pepsin. It is warmed to 140° F. and kept at this temperature for ten minutes. Then it is allowed to stand at room temperature for a half hour. The curd is then separated from the whey and placed in a cheese-cloth bag and allowed to drip in the refrigerator overnight. The curd is then worked through a fine sieve and at the same time there is added one pint of a low acid buttermilk and one pint of water or enough water to make a quart of finished protein milk, to which is added one grain of saccharin. The buttermilk is made from fat-free milk. When using, only warm slightly to avoid curdling. For commercial purposes protein milk is desiccated and sold in the form of a powder. This product has the same effect as the freshly prepared protein milk.

Tumor of the Brain.—SPILLER (*Arch. Neurol. and Psychiat.*) reports a case of a boy of twelve years of age who was operated on and there was found a telangiectasis, which was congenital. He was benefited by the operation. Spiller says that it is interesting to note that this boy with the telangiectasis of the cortex had pronounced associated movements, and developed convulsions which were not Jacksonian, but involved both sides of the body. Probably these convulsions, like the voluntary and associated movements, originated in the right motor cortex. The loss of stereognostic perception of the right hand might be attributed to the lesion of the left parietal lobe. The diminution of the right side of the body and limbs was in association with the motor tract from the left cerebral hemisphere. It is common to find arrest of muscular development in the paralyzed side in early acquired or congenital hemiplegia, and the author says that this is dependent on a defect of motor supply of the corresponding side. At birth the muscle may be developed independently of the motor nervous system, but at a very early period of extra-uterine life the motor nervous system takes hold and defect of the former leads to defect of the latter.

The Etiology and Treatment of the Diarrheal Diseases of Infancy.—HILL (*Jour. Am. Med. Assn.*, 1919, lxxii, 1653) rather definitely divides the diarrheas according to etiology and treatment, reflecting the teaching of the Boston School of Pediatrists. Any diarrhea is caused by increased peristalsis. This increased peristalsis is caused by some irritant acting on the intestinal mucous membrane, and it is best to classify diarrheal conditions according to the type of irritant causing the trouble: (1) mechanical diarrhea, due to mechanical irritation; (2) fermentative diarrhea, due to chemical irritation; (3) infectious diarrhea, due to bacterial irritation. In the first group the irritation is mechanical and is caused by undigested pieces of food or by such things as fruit-skins or seeds. In the second group the trouble is caused by irritating products from the fermentation or putrefaction of food in the intestine. There is no infection by bacteria of the intestinal mucous membrane in this condition; it is the intestinal contents that are infected. In the third group there is actual invasion of the intestinal mucosa by bacteria, with catarrhal inflammation or often actual ulceration. The treatment of mechanical diarrhea consists simply in purging the child with castor oil or calomel, putting it to bed, giving it barley water or some other gruel for twelve hours, with plenty of water, and then starting it on a bland non-irritating diet of cereal and boiled skimmed milk. This is the simplest and least important of the infantile diarrheas. Fermentative diarrhea is caused by sugar or protein. In mild sugar fermentation a purge is not necessary unless the baby has fever. All sugar should be omitted from the milk modification and the solution boiled for three minutes. One teaspoonful of compound chalk mixture should be added to each bottle. In two or three days the baby will be back on its regular modification. In the more severe forms Hill recommends albumin, milk, skimmed milk with powdered casein, lactic acid milk, or in out-patient work skimmed milk dilutions alone. It is a mistake to give a purge as a routine. It is not rational to purge a baby who is already having a great many loose stools a day. On the other hand a baby who is seen at the onset, who

has fever and who has not as yet been emptied by diarrhea ought to be purged at once. Colon irrigation at the onset may do a great deal of good. The free administration of water is of the greatest importance. When air hunger develops sodium bicarbonate should be given at once by mouth, subcutaneously or intravenously. Compound chalk mixture is of value in many cases, and in the fermentative diarrheas does more good than bismuth. As to opium we should not slavishly follow a set rule and refuse to give it in all cases. The stimulants brandy and caffeine are often needed. In the more uncommon protein form of fermentative diarrhea the stools are brown and foul instead of being green and acid smelling, as in the sugar form. Here a low protein and a fairly high carbohydrate diet is needed. Infectious diarrhea may arise in a number of ways, the most common one being direct infection of the mucosa by dysentery bacilli taken per os. The streptococcus and the *Bacillus aerogenes capsulatus* are probably etiological agents also. The general treatment is the same as that for fermentative diarrhea, which has been outlined. The feeding is quite different. As regards diet, cases of infectious diarrhea must be divided into two groups: The first group includes cases caused by the dysentery bacillus or more rarely by the streptococcus. The second group of cases is caused by the gas bacillus. The gas bacillus cases should be fed on a lactic acid milk with a low sugar while the dysentery ones should receive low protein and high carbohydrate.

Autoserum Treatment of Chorea.—BROWN, SMITH and PHILLIPS (*British Jour. Children's Dis.*, 1919, xvi, 8) again bring up the subject of autoserum treatment of chorea, originally proposed and used by Goodman. They describe the technic and call special attention to the importance of suspending drug therapy for five days previous to the injection. Their results are: autoserum therapy has been productive of infinitely more satisfactory results than any other method of therapy, a cure of 77 per cent. of the cases being effected within three weeks' time. There have so far been no recurrences in a period of over a year and a half.

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

Extraperitoneal Cesarean Section in Infected Cases with the Carrel After-treatment.—MARKOE and MCPHERSON (*Surg., Gynec. and Obst.*, August, 1918) limit the use of the extraperitoneal operation to cases in which the child is living and the patient who is presumably infected and cannot be delivered of a living child through the normal passages. These conditions contra-indicated craniotomy or other vaginal interference for the maternal mortality of craniotomy in the lying-in hospital

was 12.5 per cent., with a fetal mortality of 100 per cent. The writers believe that it is virtually impossible to have the peritoneal cavity open and not to infect it when the septic contents of the uterus must necessarily invade everything in the immediate surroundings when the child and placenta are removed. Markoe has performed 5 transperitoneal operations: 1 for the toxemia of pregnancy, 1 for just minor pelvis, 1 contracted pelvis, with a history of interference before admission, 1 with contracted pelvis, with repeated efforts for three days to deliver, and 1 with a history similar to the preceding. McPherson also performed the operation of extraperitoneal section with fairly satisfactory results. With the advent of the Carrel-Dakin method it seemed possible to rapidly sterilize these wounds and thus secure more prompt and perfect union, and the writers believe that the extraperitoneal section with the Carrel-Dakin method may be employed in patients in whom the child is living, but when the mother is infected and cannot be delivered of her child by the natural passages. The advantages of the operation are the avoidance of sepsis; the disadvantages are the fact that the operation is not easy and that injury may occur to surrounding tissues. The objections lie in the fact that the operation is not simple and in inexperienced hands may prove formidable. The operation is not one to be adopted by the general practitioner but by those with hospital facilities and surgical experience.

Obstetrical Anesthesia during Labor.—PALMER (*California State Jour. Med.*, 1918, No. 16) gives his results in the use of nitrous oxide and oxygen in the clinic of the Stanford University Medical School. It was found that substance does not delay labor in the second stage and that it may be so given as to shorten the duration of labor or the use of forceps. The continued administration of nitrous oxide and oxygen, or a moderate degree of anesthesia is best, using a small quantity of ether as the child is delivered from the perineum to secure relaxation. It is best not to secure relaxation by decreasing the amount of oxygen given, as this is always dangerous and especially so in obstetrics. If greater relaxation is desired than is ordinarily given by gas the addition of ether is safer. In version and in any operation when it is especially desired to secure relaxation gas with ether or ether and oxygen made the best combinations. The use of nitrous oxide and oxygen seems to have no effect upon the occurrence of postpartum hemorrhage. It tends to prevent lacerations and may be employed in suitable cases in the performance of Cesarean section. It was found that the cost of the gas necessary for a case was \$2.50, and that if the patient would pay that it would reimburse the hospital for the expense.

The Effect of Placenta on the Growth of the Fetus and the Newborn Child.—HAMETTE (*Jour. Biolog. Chem.*, December, 1918, No. 36) conducted investigations to ascertain whether the use of desiccated placenta to nursing women would have an effect upon the chemical composition of the milk, whether it would improve the nutrition of infants so fed. He found that, aside from any change in the constituents of the milk, the administration of placenta to the mother stimulated the growth of the child. These patients were given 10 grains of desiccated placenta three times daily. Only those were selected who had normal

labors and only those children were studied who were fed exclusively by the mother. The mother's diet and the methods of keeping track of the infants were those which the observer had previously employed with success. The results were striking and apparent. In each child there was much less loss of weight after birth. The gain in weight was more rapid and the gain in daily weight was unusually large. By the thirteenth day the child had gained 60 per cent. over its original weight. There can be no question concerning the accuracy of the observation, as the results were so striking that they could be ascribed to nothing else. It was found that the infants thus fed had a greater capacity for growth than those whose mothers were not so treated. Very careful comparative measurements were taken of the breasts in a large series of cases in the women who were taking desiccated placenta and those who were not. The time when the milk came in full was accurately noted in these cases and it was found that there was no essential hypertrophy of the gland or increased milk production. The conclusion is reached that desiccated placenta contains some substance or substances which pass through the maternal body, retaining their active properties; passing into the child's body through the milk these substances stimulate the growth of the infant.

Obstetric Science and Art in the Service of the Nation.—DAVIS (*Jour. Am. Med. Assn.*, December 7, 1918) calls attention to recent discoveries which have improved obstetric practice and some dangerous tendencies at the present time. Among these he especially draws attention to the abuse of pituitrin. The treatment of puerperal septic infections by vaccines and sera, while it has not proved of great value, still may be in the future more efficient. There has been great improvement in our knowledge concerning the toxemia of pregnancy and the recognition of the fact that pernicious nausea and vomiting depend upon that cause. In obstetric surgery especial gains have been made which are already doing much to make the mother's recovery from labor complete and to rescue her from becoming an invalid. When, however, the general field of obstetric practice is investigated it is found that there is great room for improvement. The trouble lies in the circumstance that careless and sometimes ignorant and unscrupulous physicians continue to undertake complicated and difficult deliveries without adequate assistance and in the most unfavorable surroundings. The multiplication of maternity hospitals, good roads and motor cars make it possible in many cases to remove the patient promptly to the hospital. Improvement in medical education, especially among students, should lead to the prompt recognition of serious complications and the avoidance of inefficient efforts to deliver the patient by inadequate means. There are many interesting problems in obstetrics still remaining for solution, among them the importance and varying manifestations of infection by the *Bacillus coli communis*. It has been abundantly proved by clinical observation that the pregnant patient is especially prone to this complication and that it may affect the appendix, the gall-bladder or the kidney. There will be no essential diminution in the mortality and morbidity of puerperal septic infection until complicated cases of obstetrics are considered as important, as dangerous and as imperative as appendicitis, infection of the gall-bladder or other acute and serious

abdominal conditions. If the general practitioner would abstain from fruitless efforts to deliver in such cases and promptly summon competent obstetric aid the lives of many mothers and children would be saved. The importance of maternity hospitals can scarcely be overestimated in this regard. In the present condition of the world it is of the greatest importance that a sound and vigorous population be given to the United States. Hence the value of improvements in obstetric education and practice.

An Operation for the Relief of Pyloric Obstruction in Infants.—CUPLER (*Surg., Gynec. and Obst.*, August, 1918) describes his operation as follows: The stomach is emptied, ether given, incision made along the upper right rectus splitting the muscle. The tumor in the stomach is then delivered and held firmly between the thumb and index finger and a longitudinal incision, 2 or 3 cm. in length, is made through the serosa and circular muscle fibers down to the thickened mucosa. After the muscle is divided the observer can detect a definite line of cleavage between muscle and mucosa. Blunt forceps, or small retractors, may be used to spread the incision apart. If the muscle be freed just sufficiently the mucous membrane will protrude into the wound. There is very little hemorrhage. Occasionally a small vessel will require ligature. Usually the application of a warm pad to the wound edges will control the oozing. In spreading the incision it is best to start at the stomach end of the incision, as here the merging of the stomach wall into the pyloric tumor is a gradual process and but little danger of entering the mucosa; whereas, the change from the thick and edematous pylorus to the neighboring duodenum is so sudden as to cause us to avoid opening the intestine at this point. The serosa is freed from the muscle enough to allow coaptation of the edges without tension, and this permits the muscle to remain in a supported position. The serosa is then brought together by two or three sutures. This operation differs from the Ramstedt procedure only in the fact that the serosa is made to cover the mucosa. Ramstedt's experience shows that there need be no fear of leakage and peritonitis. The wound should be closed in layers without drainage. The skin closed with linen, the abdomen reinforced by the application of a wide circular adhesive band. The postoperative care consists of early feeding 2 or 3 drams of diluted milk four or five hours after the operation. One to three ounces every four hours on the third day. Overfeeding is to be avoided, for edema at the operative site may occur and the symptoms return. Withdrawal of food and gastric lavage will usually correct the condition. Hypodermoclysis is often needed. The writer has employed this method in two cases. Downes describes the postmortem findings of an infant dying of endocarditis three months after a successful Cesarean operation. In this case the stomach removed showed an elliptical cicatrix on the anterior surface of the pylorus about half the size of the original wound. This area was covered with serosa and appeared to consist of serosa and mucosa only.

A Method for Determining the Maturity of the Fetus in Utero.—THOMS (*Surg. Gynec., and Obst.*, May, 1918) examines a patient to determine the maturity of the fetus by making the usual vaginal examinations, passing one or more fingers to the cervix, and if the vertex

or breech is in the birth canal it may be easily palpated through the anterior fornix. If the presenting part is too high up, slight pressure upon the fundus toward the symphysis will bring the presenting part down so it may be palpated. With the examining hand in position the finger resting against the fetal head and in a line corresponding with the longitudinal axis of the fetus, an assistant measures with the pelvimeter the distance from the uppermost point of the buttocks through the abdominal wall to any easily available point on the examining hand outside the vulva. The index finger of the other hand of the examiner is now placed at the point against the tip of the pelvimeter. The reading is made, and with the finger-tip of the non-examining hand still in position the examining hand is withdrawn from the vagina. The distance from the tip of the examining finger to the point where the pelvimeter rested is now measured. This reading subtracted from the former reading will give the distance from the vertex to the uppermost point of the buttocks after subtracting a small amount for the thickness of the abdominal and uterine walls. If the examining finger has rested against the fetal head itself through the patent cervical canal it is the custom of the writer to deduct 1.5 cm. before multiplying by 2. If, however, the palpation has been made through the anterior fornix, either rectally or vaginally, 2 cm. are deducted. Up to the present time in cases where measurements have been made before and after birth results have been gratifying. The employment of the rectal route is obvious and requires no further description. The length of the floated child *in utero* may be determined with greater accuracy in this way than in external abdominal methods. This method is deserving of wider use, no special instruments being required. It is rapid and conflicts in no way with asepsis.

The Clinical Types of Puerperal Fever with Reference to Prognosis and Treatment.—WATSON and SCOTT (*Canadian Med. Assn. Jour.*, 1918, No. 8) have studied obstetrical and gynecological patients with regard to the occurrence of puerperal septic infection. Among 2096 puerperal cases there were 476, 22.9 per cent. showing morbidity. From the gynecological service there were 97 cases which could be traced to puerperal septic infection. A thorough investigation of these patients showed that in 85 per cent. of cases developing fever after childbirth the fever quickly subsides without the development of any definite pathological lesion. When a definite pathological lesion does develop it is not apparent for some time after the first rise of temperature. In the pelvis the infection starts as a wound infection of some part of the genital tract. This primary infection may remain localized for varying times or may spread by contiguity by the blood stream or by the lymphatics. When the infection spreads by contiguity of tissue, pus tubes, pelvic peritonitis or general peritonitis develop. The organisms usually found in these cases are the gonococcus and streptococcus. Lesions due to the gonococcus appear late in the puerperal period and are less severe than those caused by the streptococcus which appear early. When the infection spreads by the blood stream it is usually of the thrombophlebitic type, beginning in the thrombosed veins of the placental site. But this may occasionally rise from a primary infection in the perineum or vagina. When infection spreads

by the lymphatics it gives rise usually to cellulitis or to a septicemia. This is especially serious and often results in death. It does not seem to be the type of organism which determines the severity of the infection as the situation in which that organism is growing. At present we have no means of treating primary infection of the uterus without favoring the extension of the inflammatory process to the surrounding tissues and the blood stream. Therefore all cases in the early stages should be treated expectantly. When a distinct pelvic lesion does develop it should be dealt with on surgical principles. Puerperal sepsis is the same whether the sepsis follows labor or follows abortion.

The Abuse of Pituitary Extract in Obstetric Practice.—MARCHAND (*Boletín de la Asociación Médica de Puerto Rico, San Juan, 1918, No. 14*) relates that midwives in Porto Rico have learned the use of pituitrin and use it blindly in all sorts of obstetric cases. As a result lacerations and other complications of labor are becoming frightfully common. The sale of this drug should be restricted and it should not be placed in the hands of ignorant midwives. A recent case is described in which a primipara was given four injections of pituitary extract. When seen the woman was moribund, lying in a pool of blood, with an inverted and relaxed uterus exposed to view. In another case Marchand had time to reduce the uterus and combat the collapse which followed a terrific hemorrhage. This primipara had three injections when the cervix had scarcely begun to open. Judicial reprimand of the midwife who had charge of such a case does little good. Even in the hands of experts pituitrin is a drug which must be used with great caution. It was urged that restrictions similar to those placed on the sale of narcotics should also be enforced concerning the sales of pituitary extract.

A Case of Abdominal Pregnancy at Term.—NOBLE (*Am. Jour. Obst., December, 1918*) reports the case of a woman, aged forty-two years, the mother of one child, three years old. As the time for her period passed the patient introduced into her uterus a catheter to bring on menstruation. After this she had at first a bloody and then a purulent discharge. She was in the hospital violently ill, with a temperature of 104° , and abdominal pain, sweating, vomiting, distention and loss of weight. She was said to be too ill for any operation, but finally improved and was able to leave the hospital and to change her residence. She continued to have a purulent discharge from the uterus and consulted physicians, who made various diagnoses. When she consulted the writer she was still having purulent discharge from the vagina. She had recovered her general health, had gained in weight, but sometimes suffered from severe abdominal pain, lancinating in character, usually occurring at night, referred to the lower abdomen and in varying location. Normal menstruation did not return. No blood had been discharged from the uterus since a short time after the introduction of the catheter. The abdomen was diffusely enlarged and no well-defined mass could be made out. On vaginal examination there was a mucopurulent discharge. The vaginal wall was dark in color, raised in temperature and boggy on palpation. A hard, globular body was felt just above the perineum behind the posterior vaginal wall, crowding the cervix so far upward that it could not be felt. By careful examination it could be made out

that this was the head of a living fetus. Under rest, restricted diet and elimination from the bowel abdominal pains ceased and the general health had improved. She was then allowed to go home and told to return as nearly as possible at the latter end of the pregnancy. Abdominal section was then performed. The amniotic sac lay beneath the abdominal wall, through which could be plainly seen a vigorous fetus. The omentum and transverse colon were across the upper border of the sac and adherent. There were no adhesions between the amniotic sac and the anterior abdominal wall. An effort was made to separate the omentum and transverse colon from the amniotic sac, but the attempt resulted in rupture of the sac. A vigorous well-developed female child was delivered and cried as soon as born. The cord was tied and cut and the membranes were adherent to the omentum, transverse colon, intestines and mesentery. The placenta was very large and was attached to the mesentery of the sigmoid, the posterior aspect of the broad ligament and the floor of the pelvis. The placenta was removed until the broad ligament was reached, when a hysterectomy was performed. The mesentery was ligated and removed where the placenta had been attached, and the appendix was also removed and the abdomen closed without drainage. The mother recovered without incident and nursed her child.

Fetal Deaths during Labor.—REED (*Surg., Gynec. and Obst.*, May, 1918) finds that out of 100 infants from 4 to 6 die during labor, or soon after, as the result of parturition. Some perish from a maternal or fetal disease of a definite character like syphilis or hemophilia, injury to the brain or pneumonia. But excluding these asphyxia is the most usual cause of death. This may be described as a condition of the infant in which there is no sign of life except the beat of the heart. It is not a pulselessness in the ordinary sense of the word, but a lack of the function of respiration. One can readily understand that this may follow coiling of the cord about the child's neck or pressure from any source upon the umbilical cord. So long as the membranes remain unruptured the danger to the infant is extremely slight, but after the membranes rupture immediate danger is present. The force of uterine contraction is sufficiently great to cause decided pressure upon the child and also to interfere with the exchange of oxygen between mother and child. The longer the contraction and the shorter the intervals between them the greater is the child's danger. Intra-uterine pressure is such that if a column of mercury stood at 80 before the rupture of the membranes it rises to 150 or more afterward. If presentation and position are abnormal some parts of the uterus are under greater pressure than others. This alters the blood supply and oxygen starvation begins with retention of carbon dioxide in the fetal blood. Compression of the cord or placenta may also occur, and if the placental site is unusually soft and spongy it may be contracted to a dangerous degree. The fact that the uterus reduces its volume may also influence the child unfavorably. The soft parts of the birth canal also expose the child to danger from unusual pressure, and this is especially marked in the first labor. It is estimated that there are three times as many stillbirths among primipara as among multipara. So too a very large child will add to the dangers of mother and infant. So the age of the mother (over

thirty) and the sex of the child (male) may also be unfortunate factors. The prolongation of labor is a distinct danger to the child. This may be inferred from the fact that when the labor goes beyond one hour in the primipara the fetal mortality is 8 per cent. Should labor be over two hours the mortality rises to 18.3 per cent. In a large series of cases in which the labor lasted two hours or more 18.32 of the cases were born asphyxiated, 1.7 per cent. were stillborn and 5.5 per cent. died later. Among the four-hour cases 49.65 per cent. were asphyxiated, 5.59 per cent. were stillborn and 6.22 per cent. died during the next few days. Obviously vertex presentations are least dangerous and transverse are most dangerous, with a mortality of 39 per cent. Statistics indicate that a face presentation was a little more than one-half as dangerous as a breech, 13.21 per cent. respectively. The fetal mortality of breech presentation should be remembered in selecting methods of delivery. In breech cases the cord is compressed, the child's mouth is surrounded with amniotic liquid or buried in the soft tissues of the mother's body. Under these circumstances the child becomes asphyxiated in a few minutes and will die in from eight to ten minutes, for immediately the umbilicus passes the vulva the cord is compressed between the pelvic brim and the head and shoulders, and hence the child must be promptly delivered. In vertex presentation great care must be taken to guard against excessive compression as well as delayed labor. Paralysis of the inspiratory or respiratory center may occur while the child has a good heart-beat at birth and a good circulation, but cannot be brought to breathe. So-called "blue babies" from partial asphyxia gives the better prognosis, for the reflexes are not yet lost. In pallid asphyxia the muscle tone has disappeared and the child's heart-beat is feeble and irregular. The stage of irritation of the pneumogastric nerve has been succeeded by that of paralysis. Male children suffer more often from asphyxia than female, probably because of the greater size and also the fact that there are more male infants than female. Contracted pelvis is an evident cause for the death of the fetus in labor. The use of forceps usually results in cerebral compression to some degree, and this can be demonstrated if the stethoscope be applied while traction is made. Coma and edema of the lungs in the motor spasm of the respiratory muscles, premature separation of the normally implanted placenta and placenta previa all cause fetal death. The fetal mortality of placenta previa is at least 50 per cent., while in separation of the normally implanted placenta only 1 in 15 survive. The question of the influence of anesthetics upon the unborn child is one of considerable interest. Unless anesthesia be deep and prolonged there need be no essential harm to the child. Gas and chloroform are more dangerous than ether under ordinary circumstances. The intermittent use of gas is possible for some time without injury to the child. This is probably true to less extent of ether and chloroform. So far as twilight sleep goes, like other methods the results depend largely upon the way in which it is done. Any anesthetic continuously administered for a long time will certainly injure the fetus. Any anesthetic may be skilfully used at short intervals for a moderate time without danger of a fatal result. Pituitrin has undoubtedly caused the death of many children and can safely be used only under certain circumstances. Its indiscriminate use is exceedingly dangerous. We recognize

the fact that death of the fetus may follow inspiration of amniotic liquid, meconium or vernix caseosa. The diagnosis of fetal death before delivery may be difficult. Fetal heart sounds give the best information pertaining to the state of the child. During the second stage the heart sounds should be counted at frequent intervals and observed before, during and after pain to be sure that the normal rhythm is present. When the heart-beat is greatly lessened or increased there is danger to the child. Pituitrin causes reduction in the heart-beat, but when small doses only are given the heart resumes its normal condition. Slowing of the beat, increased rapidity and irregularity are positive signs of danger. Slowing is most common and usually caused by carbon dioxide intoxication or by acidosis, which irritates the pneumogastric nerve. It is of importance only when it persists during the interval between pains. If the pulse sinks below 100 in the interval there is danger and labor should be terminated. In the further stage of involvement the pulse is 160 or more to the minute. This indicates positive danger to the infant. In the third degree the heart beat is irregular, which means threatened paralysis of the pneumogastric. When the variation exceeds 50 beats, interference should be attempted in the interests of the child. When the heart-beats cease, obviously fetal death has occurred. If proper antiseptic precautions are taken, or if the assistant, who is accustomed to do so, listens to the heart-beat of the fetus, there can be no objection to frequently listening to the heart-beat during labor. Pituitrin should never be given in doses larger than 10 minims and the child's heart-beat should be watched after this dose. Care in the use of anesthetics will also prevent fetal mortality and prolonged anesthesia must be avoided. The rebreathing of gas should not be permitted in the interests of the child. If the woman is toxic or has high blood-pressure, neither gas nor chloroform should be used. If morphin-scopolamin is given the patient must be at least three hours away from the end of her labor. From 10 to 15 per cent. of infants born in asphyxia die during the next eight days. This result occurs from atelectasis, convulsions, paralysis, pneumonia or some congenital condition which prevents the readjustment of the child's vital forces after birth.

Prevention of Gas Pains after Obstetric and Other Operations.—EMGE (*Jour. Am. Med. Assn.*, September 14, 1918) calls attention to what he believes to be a wrong conception illustrated by preparatory purgation before operation. His arguments apply with equal force not only to surgical operations, but also to parturition. He does not believe that the patient is put in good condition by starving and purgation. Various authorities are quoted expressing the belief that such preliminary treatment is harmful. It is interesting to note what happens in emergency operations. In emergencies such as tubal pregnancy or Cesarean section patients do well who have not been subject to preliminary purgation. In spite of the fact that these patients must be operated on in haste they have no more complications after operation and oftentimes less disturbance than those who have been prepared by purgation. It will be remembered that in operating upon patients who have not been purged that the intestine is usually less distended, does not escape from the abdomen so readily and is far more easily handled

than in patients who have been thoroughly purged before operation. Experiments on animals have shown that disturbance of the portal circulation interferes with the absorption of gas. This is an important point, because active purging in preparation for operation. When, however, the mesenteric circulation was absolutely at rest the formation of gas was comparatively little. A comparison is made of patients who had been treated before labor or operation by active purgation and those who had not. The best results with patients were observed in those who had no purgation prior to labor or operation, but received a cleansing enemata just before the operation. It was also seen that patients who had been prepared by purging before labor or operation had gas pains and cramps much more frequently than those who were not so prepared. These observations may be summarized by the statement that purging before labor or operation has much to do with producing gas pains. Should it be necessary to open the abdomen in delivery it will be found that the intestines in patients who have been purged are much more distended and difficult to control. Enemata will clear the lower bowel sufficiently for all practical purposes.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA,

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Permanent Rectal Cloaca.—A case in which for over thirty-five years a woman defecated and urinated and for eleven years menstruated by the rectum is worthy of a final record as an evidence of the possibilities of surgery and especially of the conclusive evidence it affords that the rectum can be utilized as a common cloaca for the urine and the menstrual flow as well as for the feces for an indefinite period. The condition necessitating this novel use of the rectum was a case of extensive and incurable vesicovaginal and rectovaginal fistulæ caused by sloughing as a complication of typhoid fever. The patient was a woman, thirty-five years old, who first came under the observation of KEEN (*Ann. Surg.*, 1919, lxi, 606) in 1873. In 1872 she nursed her husband in a fatal attack of typhoid fever and then fell ill of the same disease. About the fourth week the labia minora sloughed away and both urine and feces escaped through the vagina. Six unsuccessful attempts were made to close the fistulæ by plastic operations, and in 1875, being convinced of the impossibility of success, Keen proposed to her the absolute closure of the vagina, leaving the fistulæ wide open, which she at once accepted. The operation was a success except at the

anterior end of the cicatrix, which held everywhere else but failed at the internal end of what was left of the urethra, the vesical end of which had sloughed away. Several minor but always unsuccessful operations were done here until finally he excised this small end of the urethra. This was her twelfth operation and was entirely successful. After the operation fistulæ in the cicatrix broke out in 1877, 1896 and 1904, usually causing only a little leakage and only when in the erect posture. Once the fistula healed spontaneously, once after a minor operation and the third time after several small pockets were emptied of urinary concretions. At the date of her death in 1911, at the age of seventy-three years, she had remained dry and well, with the exception noted for over thirty-five years after the closure of the vaginal outlet. During all this long period she urinated only once or twice at night and five or six times during the day. No ascending renal, vesical or uterine infection occurred at any time nor did the mucous membrane of the rectum at any time resent the constant presence of the urine or the periodical presence of the menstrual blood.

Tuberculosis of the Cervix.—While tuberculosis of the cervix is very rare indeed, undoubtedly many cases have been diagnosed early cancer, syphilis, etc., without histological study, and MOORE believes (*Surg., Gynec. and Obst.*, 1919, xxix, 1) that many cases of early cancer of the cervix diagnosed from the clinical symptoms, which have recovered spontaneously or after conservative operations, were tuberculous. Primary tuberculosis of the cervix is an extremely rare disease and probably not more than 15 to 20 cases have been reported. As primary infections, we should include only those cases in which the cervix is the only organ involved. When other distant organs are involved it is impossible to rule out a hematogenous infection even though infection by an external route seems plausible. Of the secondary tuberculous infections of the cervix, probably about 150 cases have been reported. The portal of entry in these infections is quite variable, although hematogenous infection is the most common means of attack. The next most common route of infection of the cervix is by direct extension of a tuberculous process from the tubes, ovaries or uterus or by secretion from these organs passing over the cervical mucosa. External means as a method of infection of the genital organs have been a subject of much interest to investigators of these lesions. The most frequent method by which bacilli are brought in contact with the female genitalia from external sources is by coitus. The other means are by handling with unclean gloves, hands or instruments in making examinations. There are four different varieties of lesions of the cervix commonly mentioned, and two others that occur in very rare instances. These are classified according to their anatomical and microscopic forms: (1) miliary, (2) interstitial, (3) vegetating, (4) ulcerating, (5) catarrhal form of Schutt, (6) inflammatory form of Cotte. In the majority of cases all types begin in the cervical canal, only occasionally on the vaginal portion of the cervix. In the later stages all types of lesions develop into the ulcerative form resulting in a purulent vaginal discharge and more or less hemorrhage. The microscopic appearance of tuberculosis of the cervix depends upon the stage of the disease and the type of lesion. Tuberculous follicles may be isolated or confluent in

different stages of evolution, accompanied by an intense inflammation. The process is often found extending along the course of the vessels, with involvement of the deep intermuscular tissues causing necrosis of muscle bundles. The glands often undergo hyperplastic changes, the cells becoming enlarged and the secretions abundant. Tuberculous infiltration may develop in the interglandular spaces, blocking up the neighboring glands so that they appear as solid columns of cells. Retrogression changes finally occur, resulting in necrosis and caseation. Giant cells are rarely found in the glands proper. During the earlier stages the glands may become papillary, polypoid or dendritic, resembling carcinoma or the glands and stroma may hypertrophy, resembling adenoma. The most common symptom is leucorrhea. In the early stages the discharge is slight, mucopurulent and inoffensive. During the later stages, as ulceration increases, the discharge becomes profuse, purulent and very offensive, and in rare cases is tinged with blood. Slight bleeding after coitus is a fairly frequent occurrence, and this is what brings the patient to examination. In the very late stages there may be considerable blood in the discharge, but this differs from the watery, blood-stained discharge of carcinoma, as it is purulent and offensive. Clinically the diagnosis is always difficult, as all stages of the disease resemble carcinoma, and a specimen for microscopic examination should be taken in every case, and owing to the similarity in microscopic appearance, it will be necessary to resort to guinea-pig inoculations in certain cases, while the coexistence of carcinoma and tuberculosis should not be forgotten. The final decision of the method of treatment in a given case should be made only after a careful consideration of the patient's general condition. If there is an active process elsewhere in the body, excision of the local process will be of no benefit. If the patient desires to have children, and the general physical condition will permit it, a conservative operation should be done, provided that the uterus and tubes are not extensively involved. If the question of child-bearing is not to be considered, panhysterectomy should be done whenever there is reason to believe that the uterus or tubes are involved. The prognosis depends entirely upon whether there are active lesions in other parts of the body and on the complete eradication of the local process. In cases with pulmonary involvement, the prognosis is always grave. When the process is definitely localized in the cervix, simple amputation gives good results, or if localized in the generative organs alone, panhysterectomy will effect a cure; but if there is extension to the vaginal walls or the pelvic peritoneum, there is little hope of cure.

Vaginal Hernia.—Judging from the very few cases reported, vaginal hernia must be of extremely rare occurrence, and for this reason SWEETSER (*Ann. Surg.*, 1909, lxi, 609) has reported a case that has come under his observation. Clinically the case resembled the ordinary rectocele, but under anesthesia, examination of the rectum revealed the fact that it was not prolapsed and took no part in the formation of the swelling, and upon careful dissection the tumor wall was found to be peritoneum, which was very thin but easily separated from the anterior rectal wall. The sac was opened and some clear yellow fluid drained away, but no coils of bowel appeared, which was due to the fact that the omentum was adherent to the upper wall of the hernial cavity as a result of an old

inflammatory disease. The abdomen was opened and the hernial opening the pelvic floor was closed by sutures which included the sacro-uterine ligaments. The sac was excised and the vaginal incision closed. As regards diagnosis, these herniæ have been mistaken for prolapse, for vaginal cyst and for abscess, and several have been operated upon under such mistaken diagnosis, the gut being incised or even excised with fatal results. It is therefore well to bear in mind that such herniæ do occasionally occur.

The Menopause.—Although this article was written by NORRIS (*Am. Jour. Obst.*, 1919, lxxix, 767) ten years ago and published at that time, at the request of numerous subscribers, the publishers have again printed it, and on account of the extreme importance of this subject a brief abstract is deemed worthy of consideration. Norris has made a very careful study and analysis of 200 apparently normal cases in order to determine the exact character of a normal menopause, concerning which there has always been so much mystery and confusion. His conclusions are that menstruation being dependent upon an ovarian secretion, it is fair to assume that the menopause is due to a change in the ovary, which theory is borne out by clinical facts, histological studies and animal experimentations. The generally accepted statement that the menopause is established at forty-two to forty-five is incorrect, but forty-six to forty-nine is nearer the actual age in the Eastern United States. Among normal women the age at which the menopause appears varies within wide limits, being influenced by many factors: child-bearing, marital relations, good nutrition and hygiene, city life and education prolong the menstrual functions, while converse conditions tend to an earlier menopause. Climate and race undoubtedly play a definite part in the age at which the menopause occurs, but are probably of secondary importance in the United States. Hereditary influence is in many cases a potent factor, since in some families the menopause occurs early, in others late. In the majority of cases the chief feature of the menopause is not the cessation or diminution of bleeding, but the neuroses which frequently antedate any change in the menstruation may continue for six to eighteen months after the final cessation of bleeding. The actual bleeding is, however, the barometer of health and normally the menopause is established without an increased loss of blood. When menorrhagia occurs an examination is indicated, while metrorrhagia should always be viewed with suspicion. In about 90 per cent. of absolutely healthy women the menopause occurs normally, but among average women fully 30 per cent. present symptoms which call for a careful physical and gynecological examination. All women at the menopause should be under the observation of a physician, since care of the cases at this time will result in the menopause being established with less discomfort to the patient and many malignant neoplasms will be diagnosed earlier than would otherwise have been the case.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

OSKAR KLOTZ, M.D., C.M.,

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

The Precipitin Test for Blood in Feces.—HEKTOEN, FANTUS and PORTIS (*Jour. Infect. Dis.*, 1919, xxiv, 482) studying the precipitin test as applied to human feces, using antihuman rabbit serum, reported very limited value of this test as compared with chemical tests. They believe that the only practical value of the precipitin test for human blood in feces could be in cases giving a negative precipitin test and a positive reaction with the Weber or benzidine tests, as the negative result would indicate that the positive chemical tests were probably due to some other factor than human blood.

A Functional and Pathological Study of the Chronic Nephropathy Induced in the Dog by Uranium Nitrate.—In 1888 Chittenden and Hutchinson reported their observations on the production of an acute nephropathy by uranium salts. Subsequent observations have dealt largely with the type of the pathological response on the part of the kidney and the processes of repair which take place in the kidney during its recovery from the acute injury. MACNIDER (*Jour. Exper. Med.*, 1919, xxix, 513) undertook an investigation to study the functional capacity of the kidney during the period of the acute injury from uranium and also when the kidney is recovering from the acute degeneration and passing into a stage of chronic injury. Observations were also made of the changes in the acid-base equilibrium of the blood of these animals both during the period of acute injury and the stage of repair. Twenty-seven female dogs, varying in age from five months to ten and a half years, were used in the experiments. The author's studies confirm the work of Dickson, who demonstrated that uranium would produce in certain of the lower animals a chronic kidney injury comparable with certain of the chronic diffuse nephropathies of man. The severity of the acute degenerative changes in the kidney is largely dependent upon the age of the animal. The older animals develop a more rapid and severer type of intoxication than the younger ones. The intoxication is characterized by a reduction in the alkali reserve of the blood and by the development of a kidney injury. The injury is expressed functionally by the appearance of albumin in the urine, a reduction in the elimination of phenol-sulphonephthalein and by a retention of blood area. All animals intoxicated by uranium have shown a disturbance in the acid-base equilibrium of the blood, as indicated by a reduction in the alkali reserve and by a decrease in the tension of alveolar air carbon dioxide. In the younger animals when an attempt at repair takes place the depletion of the alkali reserve of the blood is in part restored, and with the regeneration of epithelium in the younger animals the functional

capacity of the kidney improves. Repair in these animals leads to the development of a chronic diffuse type of nephropathy in which the acid-base equilibrium of the blood may be maintained at the point of normality.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

MILTON J. ROSENAU, M.D.,

PROFESSOR OF PREVENTIVE MEDICINE AND HYGIENE, HARVARD MEDICAL SCHOOL,
BOSTON, MASSACHUSETTS,

AND

GEORGE W. McCOY, M.D.,

DIRECTOR OF HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE,
WASHINGTON, D. C.

Narcotic Drug Addiction as Regulated by a State Department of Health.—BLAIR (*Jour. Am. Med. Assn.*, 1919, vol. lxxii, 1441), believes that after sufficient administrative machinery, both federal and state, is developed, the importation and sale of all habit-inducing drugs should be made a government monopoly; that it should be unlawful for any physician to prescribe or dispense any of these drugs in any but the accepted therapeutic dosage under any conditions or to buy or possess them in quantity greater than the legitimate therapeutic needs of his own or institutional practice fully justifies; that pharmacists be prohibited from selling them in any quantity whatsoever, and he be allowed to fill no prescription calling for more than the usual therapeutic dosage; and that no ready-made or proprietary product carrying any narcotic whatever be allowed to be sold. He would have an official, not in medical, pharmaceutical or dental practice, in every district to whom every particle of the government supply for the district should be sent. It would be his duty to estimate the legitimate needs of all professional people and to supply them so much and no more, except in time of public emergency or unusual circumstances. To him should be reported every addict in the district, even inoperable surgical cases, as well as all persons requiring on the testimony of a physician, doses in excess of the usual; and this official would supply to these persons such amounts as would appear necessary, humanely caring for the addicts already made, but sternly refusing to supply new ones except those with diseases which positively demand large doses. This plan would yield definite results and would relieve the physician of an unwelcome class of work that, in the nature of the case, he cannot handle well. Perhaps there would be much medical objection at first, but the plan would probably work so well that the profession at large would soon come to support it most enthusiastically. Certainly it would relieve the profession of a great amount of narcotic bookkeeping and reports, and would control the problem much better than does any existing plan.

Etiology of Yellow Fever.—NOGUCHI (*Jour. Exp. Med.*, 1919, xxix, 547) states that the clinical and pathological features of the yellow fever prevalent in Guayaquil conform with those described by other investigators of this disease as it has occurred elsewhere, both epidemically and endemically. By injecting into guinea-pigs the blood of yellow fever cases occurring in Guayaquil a group of symptoms and lesions closely resembling those observed in human yellow fever were induced in a limited number of instances. Of 74 guinea-pigs inoculated with specimens of blood from 27 cases of yellow fever, 8, representing 6 cases, came down with the symptoms. In the blood, liver and kidneys a minute organism was demonstrated which closely resembles in morphology the causative agent of infectious jaundice (*Leptospira icterohemorrhagiæ*). The leptospira transmitted from yellow fever cases to guinea-pigs was found to induce similar symptoms and lesions upon further passage into normal guinea-pigs. The leptospira obtained from cases of yellow fever has been given the provisional name of *Leptospira icteroides*. Noguchi reports studies on the type of disease induced in guinea-pigs, dogs and monkeys by inoculating them (1) with the blood or organ emulsions of guinea-pigs or other susceptible animals experimentally infected with *Leptospira icteroides*, and (2) with a pure culture of the organisms. The symptoms and pathological lesions induced in guinea-pigs are much more pronounced than those observed in dogs or marmosets. The period of incubation is nearly the same in all three species, seventy-two to ninety-six hours with intraperitoneal or subcutaneous inoculation, and a day or more longer when the infection is induced percutaneously or *per os*. The symptoms and lesions observed in animals experimentally infected with *Leptospira icteroides* closely parallel those of human yellow fever. The pathological changes occurring in human cases of yellow fever are similar to those induced by inoculation in guinea-pigs and marmosets and in respect to their intensity stand intermediate between those arising in the two animals mentioned.

Experiments on the Mode of Infection in Epidemic Meningitis.—AMOSS and EBERSON (*Jour. Exp. Med.*, 1919, xxix, 605) state that the lower monkeys as represented by *Macacus rhesus* are resistant to a high degree to infection with cultures of the meningococcus introduced into the general blood. The lower monkeys are less resistant to infection when the meningococcus cultures are injected directly into the subarachnoid space by lumbar puncture. Relatively virulent cultures, which have been passed through several monkeys, acquire the power of surviving in the circulating blood of the monkeys for a maximum period of about seventy-two hours. Nothing has, however, been observed to indicate that the injected meningococci actually multiply in the blood. It has not been found possible to direct the meningococci circulating in the blood into the cerebrospinal meninges of monkeys. In this effort an aseptic meningitis was induced by injecting horse serum, saline solution, or protargol into the subarachnoid space preceding the introduction of the meningococci into the blood. In rabbits the meningococci were able to pass into the spinal fluid from the blood when a physical break in the continuity was made; however, under the conditions of chemical inflammation of the meninges

the rabbit reacted just as the monkeys, and the organisms did not pass. Because of the high insusceptibility of the monkey to infection with meningococcus it is not believed that the experiments throw any new light on the mode of invasion of the body in man by that microorganism. The experiments do not lend any support to the notion that an intraspinal injection of the antimeningococcus serum, early in the course of invasion of meningococcus in man, and possibly at a period at which the meninges do not yet show evidences of inflammation, favor its diversion from the blood stream into the subarachnoid space.

The Effect of Diet on the Healing of Wounds.—CLARK (*Johns Hopkins Hosp. Bull.*, 1919, xxx) states that the length of the quiescent period of wound healing is affected by the diet. It varies from zero in protein-fed dogs to six days in the fat-fed animals. This variation in the quiescent period is more marked in smaller wounds. As a consequence, the date of final healing differs by about five days for the protein- and fat-fed dogs. When the second period, or period of contraction, has set in the rate of contraction is not affected by the diet. It is governed by a variable factor depending on the age of the wound and by a constant factor proportional to the original size— $\frac{R_1}{R_2} = \frac{S_1}{S_2}$ when R_1 and R_2 = rates of healing of large and small wounds and S_1 and S_2 = original areas of these wounds. The beginning of Period III, the period of epidermization, is independent of the size of the wound and the diet. It is determined by the age of the wound. Contraction and epidermization continue together until the wound is entirely healed. After the wound is healed the scar continues to contract until pigmentation sets in. During this latter process it enlarges and reaches a stationary state after pigmentation is complete.

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ORIGINAL ARTICLES.

THE CARDIAC PHASE OF THE WAR NEUROSES.*

BY ALFRED E. COHN, M.D.,
NEW YORK.

(From the Hospital of the Rockefeller Institute for Medical Research.)

IN an inquiry into the state of our own knowledge, it is useful to institute a comparison of our thoughts with those held at a former stage of development of the same subject. It is especially gratifying to be called upon to do this in the present instance, because the first serious attention was given to this matter by Da Costa, an American, and the study was of so excellent a nature as to leave no doubt that a recognizable malady had been described.

In 1871, Da Costa¹ published the account of an affection called by him "The Irritable Heart of Soldiers," in which palpitation of the heart, cardiac pain, rapidity of the heart-rate, shortness of breath and nervous disorders, such as headache, giddiness and disturbed sleep, were the dominant complaints. Associated with these, he mentioned hyperesthesia of the skin, blueness of the lips and hands and a mottled condition of other portions of the skin. Indigestion, abdominal distention and diarrhea, itching and sweating were also noticed. In certain cases, Da Costa found that the heart was normal in size, and in them it was his opinion that the affection was functional. In others he found the organ hypertrophied. In neither group was a cardiac murmur an important

* Read in part before the Congress of American Physicians and Surgeons at Atlantic City, June 17, 1919.

¹ On Irritable Heart: A Clinical Study of a Form of Functional Cardiac Disorder and its Consequences, AM. JOUR. MED. SC., 1871, i, 52.
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finding. He believed that the functional and organic affections, "apparently dissimilar states, were in reality one, or rather that one grew out of the other," and, further, that he could "demonstrate . . . the links connecting the disorders." The disorder, he thought, "either gradually subsides or it passes by degrees into cardiac enlargement." He founded the treatment on rest, and aided it by giving digitalis, atropin and aconite to relieve one or other of the symptoms, for which each remedy appeared to be especially serviceable. The soldiers, "before being sent back to their regiments, were tested by running and other exercises, with a view to seeing how the action of the heart was affected." Some he "had the opportunity of examining after they had rejoined their regiments," and of others he heard that "they were fully able to fulfil all required of them." Of especial interest is Da Costa's conception of the cause of the malady. He did not believe that he had come upon a new affection. He thought that similar complaints must have existed, and he studied, accordingly, the medical military history of other armies. He found, for instance, that "palpitation" was a cause for invaliding home to England from hospitals of the Army of the East in the Crimean War. He found mention of it also in Sir Henry Havelock's army in India. But he failed to find it mentioned in Sir John Moore's retreat, in Lord Clive's campaign in India, in Napoleon's campaign culminating in the surrender at Ulm and in his retreat from Russia. He looked for mention of it especially in these campaigns because he expected to find it in troops that had been exposed to enormous exertion, such as had been the case in these. And he was impressed with its frequency in the Northern Army in the Civil War. "Whether among the Southern Armies the same affection was common I am unable to say, though from some facts that have been mentioned to me I think it was. And it would be strange, indeed, if men of the same race, transformed into soldiers under much the same circumstances, and though operating oftener on interior lines, enduring, on the other hand, generally more privations, should have escaped. "We find," he says, "quick and long marches, heavy work, producing the affection, or even slight exertion in those whose constitution has been impaired by insufficient or indigestible food, or whose strength has suffered, or condition of the heart been disturbed by diarrhea or fever. We find it most readily developed in those previously weak and unaccustomed to fatigue or subject to rapidly quickened circulation. We find it kept up by irksome equipment and other causes, but not generated by them."

That the affection was not distinctly recognized and described earlier does not surprise Da Costa. To those who have followed the rapid additions to knowledge in the study of the behavior of the heart in the last fifteen years the observation which follows has special interest. To have recognized the affection would have been

surprising, "when," as he says, "we reflect how almost entirely the accurate knowledge of diseases of the heart is the knowledge of our time."

From Da Costa, then, we have the description of an affection so clear that there was no difficulty in identifying the cases when they appeared in the armies during this war. To his conception of the disorder, as depending upon infection and exertion and of his system of therapy, there will be occasion to return in the discussion.

Since then the affection was seen and described in India by MacLeod,² and by him was attributed to campaigning in the tropics, and was, in consequence, called the "Tropical Heart." Disability from unexplained cardiac causes had been so great that the British War Office at one time accepted the suggestion that the form of accoutrements might be responsible for the difficulty, and, therefore, altered the crossed straps for support of the soldier's pack.³ A similar thought had come also to Da Costa.

Between the Civil War and the war just finishing there has been mention a number of times of similar affections. It is, I believe, correct to say, however, that it was Da Costa's opinion which exerted the greatest influence in this field.

During the present war, cases appeared in such numbers as to direct attention to them in the Allied Armies and in those of the Central Powers. Many studies have been made in Germany and Austria, in Italy, France and England, and, more recently, in our own country. I believe the number of papers so far published exceeds 250.

In England the need for directing opinion was soon felt. The Medical Research Committee, organized under the National Health Insurance, made a first report in 1915-1916 of the investigations of cardiac disorders of military importance. In England, early in 1916, the Director-General of the Army Medical Service set aside the Hampstead Military Hospital, where these so-called cases of "Irritable Heart of Soldiers" were received for study and treatment. An advisory committee, consisting of Sir Clifford Allbutt, Sir James Mackenzie and Sir William Osler, was appointed. Dr. Thomas Lewis was called to take active charge of the work. The forethought of the British authorities in providing for the study of this important affection had important results. The usefulness of their "Report upon Soldiers Returned as Cases of 'Disordered Action of the Heart' (D. A. H.) or 'Valvular Diseases of the Heart' (V. D. H.)," written by Dr. Thomas Lewis and his collaborators,⁴ deserves special notice. To the same authorities

² Tropical Heart, *Jour. Trop. Med.*, 1898, i, 3-4.

³ Wilson, R. McN.: The Irritable Heart of Soldiers, *British Med. Jour.*, 1916, i, 119-120.

⁴ Disordered Action of the Heart (D. A. H.) or Valvular Diseases of the Heart (V. D. H.). Special Report Series No. 8, Medical Research Committee, National Health Insurance.

and to Dr. Lewis the U. S. Army is in debt for their interest in the training and instruction of the medical officers selected by the Surgeon-General's office for subsequent duty in the American Expeditionary Forces. Following the example set by the British, Major Janeway first and Colonel Longcope later made plans for the further pursuit of these studies in the United States. The Surgeon-General, accordingly, set aside 200 beds at U. S. General Hospital No. 9 at Lakewood, where a service was organized and work was carried on under the direction of Major Francis W. Peabody.

A catalogue of the symptoms of the disorder contained in the British and in other reports is not essentially different from that given by Da Costa.

I give now the description of a severe case—a not uncommon picture:

The patient is obviously distressed. His face bears the marks of anxiety; he is likely to be thin; his eyes are troubled; there are vertical furrows in his brow, the lines about his nose and mouth are drawn. His lips are bluish; his skin mottled; his hands often purple. He trembles and his trembling is a coarse shake. The shake involves his extremities, often only his hands, but I have seen men shake, arms and legs, and sometimes their bodies and heads as well. He presents a memorable picture.

He has reported sick for one of several reasons: because of breathlessness, on account of which he has been forced to fall out on hikes; because of pain in the chest, or sense of fatigue or of dizziness, or because of palpitation in his chest.

On examination the motions of the extremities are coarse and their extent is likely to increase when attention is directed to them. The skin is cold, the palms wet and clammy; profuse sweat pours from the axillæ, though the room is cool; there are areas of hyperesthesia of the skin, especially over the precordium, or, as Robey and Boas⁵ have shown, areas of hypesthesia; the tendon reflexes are exaggerated; the mucous membrane reflexes are gone. The examination of the separate organs shows no striking abnormality. The size of the heart, as Meakins and Gunson⁶ have shown, is no larger than that of normal persons, when attention is paid to body weight. There is reason to think that this need not always be true, for soldiers after campaigning may have larger hearts than persons not subject to this exertion. Karsner⁷ has called attention to this fact in a study of the weight of the heart in soldiers who were in the war more than twenty-two months and who were more than twenty-seven years old. In the measurements which I made

⁵ Neurocirculatory Asthenia, Jour. Am. Med. Assn., 1918, lxxi, 525-529.

⁶ Orthodiagraphic Observations on the Size of the Heart in Cases of So-called "Irritable Heart," Heart, 1918, vii, 1-16.

⁷ Acute Endocarditis Following War Wounds, Including Notes of Heart Weight and Arteriosclerosis in Soldiers, Arch. Int. Med., 1918, xxii, 296-311.

on 211 soldiers returned from hard service with the American Expeditionary Forces there was, however, no difference between the size of their hearts and the figures published by Dietlen.⁸ There need be no murmur. But when one considers how frequently systolic murmurs have been found during the draft examinations, one expects that unimportant murmurs will be found in a number of cases. The heart-rate is elevated and lies between 90 and 130—in 75 per cent. of the cases, according to Hume;⁹ the rate may reach over 150; but in about 10 per cent. the rate may be below 80. The blood-pressure as observed by Lewis, Cotton and Rapport¹⁰ and by Sturgis¹¹ is usually normal. Sturgis made a careful study of this point at U. S. General Hospital No. 9 and found that with proper attention to technic the systolic and diastolic pressures were quite normal, the systolic pressure being 117 mm. and the diastolic 75 mm. No doubt if pressures are read just after men have reported for examination the pressures may be high, sometimes 140 mm. or more. The high level then probably results from the elevation of rate, due no doubt, to excitement, though in examining recruits it was noticed that equally high pressures exist without elevation in rate. I do not discuss the mechanism of this phenomenon.

The breathing is rapid and shallow. The rate usually is 40, but rates of 80 have been described, and on rare occasions a constant rate as high as 200 has been seen.

This, then, may serve as a general description of the symptoms and signs. I have chosen to describe a severe case. After the experience at Colchester, where cases were severe rather than mild, one was not at first prepared for the mild cases which appeared in the hospitals of the American Expeditionary Forces in the spring and early summer of 1918. A single complaint of a mild order was rather the rule. Late in the summer and in the autumn the severe grades were common.

There will be no serious difference of opinion among medical officers that there are large numbers of cases of this sort. In the British Army, 421,877 men were discharged as unfit to August 31, 1918. Of these, 41,699, or about 10 per cent., were discharged on account of heart disease; most of them probably of the type called "Disordered Action of the Heart" (D. A. H.). In the United States Army there were rejected from February 18 to October 15, 1918, 467,694 men, of whom 61,142, or 13.07 per cent., were rejected for heart or bloodvessel defects. These figures probably include rejections at the draft and discharge from service for unfitness.

⁸ Deutsch. Arch. f. klin. Med., 1907, lxxxviii, 55.

⁹ Study of the Cardiac Disabilities of Soldiers in France, *Lancet*, 1918, i, 529-534.

¹⁰ After-effect of Exercise on Pulse-rate and Systolic Blood-pressure in Cases of "Irritable Heart," *Heart*, 1915-17, vi, 269-298.

¹¹ Personal Communication. Observations to be published.

But when the nature of the symptoms is considered, together with the physical signs, all pointing clearly to derangement of the organs of circulation, opportunity is provided for divergence of interpretation of the significance of the symptoms.

I have already indicated Da Costa's belief. Sir Clifford Allbutt¹² appears to think that the researches of Lewis and Barcroft's "seem to discover a new disease, or, rather to discriminate more exactly the features and nature of a disease less clearly apprehended already by Da Costa and others as 'soldier's heart,' or by those of us who have written upon 'neurasthenia' as 'cardiac neurasthenia.'" And Sir James Mackenzie¹³ comes to this opinion: "Taking into consideration all the facts, it will be found that the condition from which certain of these soldiers suffer, who are usually understood to have acquired a heart affection, is not, properly speaking, cardiac in origin, but is the outcome of an injury to other systems as well as the heart, such as the central nervous system." In describing the treatment he says: "They often feel miserable, so that there is a mental side to the case which is aggravated by the supposition that there is something amiss with the heart." His view is that the main trouble is one of exhaustion, the phenomena of exhaustion being more evident in one organ in one case and in other organs in other cases. Mackenzie considers the relation of cases of this type to infection and intoxication, but is inclined to separate them both in etiology and in treatment.

Lewis¹⁴ has given a detailed description of his conception of the "effort syndrome." "When a healthy man takes exercise, and this exercise is sufficiently stressful or prolonged, he becomes aware at the time of the effort, or after it has ceased, of certain symptoms, and he presents certain physical signs." Lewis describes the signs and symptoms in detail and then continues as follows: "To these physiological symptoms and signs briefly described as a group. I apply the term 'physiological syndrome of effort.' The term is used as a convenient description of the chief changes, subjective and objective, which are manifested by the human body in its relation to exercises. When I use the term 'effort syndrome' I have in mind the symptoms and signs which follow exercise in health, but I believe I recognize the same or a very similar group of symptoms and signs in a large class of patients in ill health. In patients of this class if no signs of disease are anywhere discovered I say that they suffer from the 'effort syndrome.'" In discussing the relation of the "effort syndrome" to the nervous system he has this to say: "In describing these nervous manifestations I do not wish to be

¹² The Investigation of the Significance of Disorders and Diseases of the Heart in Soldiers, *British Med. Jour.*, August, 1917, ii, 139-141.

¹³ The Soldier's Heart, *British Med. Jour.*, 1916, i, 117-119.

¹⁴ The Soldier's Heart and the Effort Syndrome, London and New York, 1918, pp. 3 ff. and p. 49.

misread. These symptoms do not stand by themselves in our patients. I regard them as additions. Few of them are, I think, essential parts of the 'effort syndrome.' Nevertheless in many of our patients the condition of the nervous system, whether it be hereditary or acquired, is such as to exaggerate those complaints which belong properly to the 'effort syndrome.' "

The symptoms which have been described may clearly be referred to the heart and circulation. But they do not correspond specifically to any given lesion of this system. They have, in consequence, by different observers, been associated with a variety of diseases, and that one or other of these associations exists has been maintained with some heat. Obviously, such symptoms occur: (1) In chronic diseases of the heart, both of the endocardium and myocardium. (2) There can be no doubt also that they occur in relation to acute infectious diseases, in which connection they are familiar. (3) They are seen in the state of hyperthyroidism. (4) They are included in the symptoms of the neuroses in peace as well as in war.

It is necessary to discuss the arguments advanced in favor of each of these views:

1. I take those views relating the symptoms to an affection of the heart. Few physicians now believe that a valvular disease exists whenever a murmur is heard. There was always general appreciation of the fact that many individuals presented murmurs that were of no prognostic importance. But it is, no doubt, safe to say that the frequency of these in the recruits that were examined during the past two years was unexpected. In 214 soldiers who had seen hard service overseas, that I examined with care, I found murmurs in 109 instances, or 50 per cent. In 68 the murmur was heard in the recumbent posture only; in 13 in the erect posture only; in 28 it was heard in both positions. One examines the relation of the murmurs to phases of respiration more carefully than formerly and attends more than formerly to the influence of posture. Without doubt the presence of insignificant murmurs has occasioned the rejection of many men for service in the army. These murmurs are usually *smooth* and accompany or follow the first sound. But *rough* murmurs immediately preceding or forming part of the first sound have also occasioned difficulty. One is familiar with this type of roughening of the first sound when the rate is rapid, and especially when there is exaggeration of the heart's action. It is possible that this roughening has been taken as a sign of mitral stenosis, the more in that the second sound is accentuated. These signs have, I am afraid, been given too great importance, the more because their occurrence exceeded in number the incidence of mitral stenosis at autopsy, 196 in 4791, or 4 per cent. at Guy's Hospital, according to the statistics of Samways, quoted by Osler.

The size of the heart has been another misleading sign in the distinction of these cases from chronic heart disease. Wenckebach,¹⁵ Karsner¹⁶ and others have indicated that the hearts of soldiers are greater than those of controls. Although without systematic roentgenological confirmation, many physicians in the Expeditionary Forces formed the same opinion, but measurements which I have recently made give a different result. Since their return to America, through the courtesy of General Shanks at the port of Hoboken, I have been able to examine 211 soldiers. The average size in these corresponds closely to the figures given by Dietlen. Given, then, possibly the enlarged heart of soldiers, the insignificant murmurs and the complaints of the men which seem to point to malfunction of the heart, it would be remarkable if the suspicion had not arisen that chronic heart disease is present. It has been shown, on the other hand, by Meakins and Gunson¹⁷ that in most of their cases of Irritable Heart the heart was actually smaller than the controls. To differentiate, involves, on occasion, making a nice distinction. But when all the factors concerned, the personal history, the circumstances of the war and an appraisal of the physical signs are taken into account there are a large number of cases in which one is satisfied that organic heart disease does not exist.

2. The relations of the symptoms of the Irritable Heart to convalescence from acute infectious disease is important, for it has been held by competent physicians that the cause of the Irritable Heart depends on this. Da Costa, for instance, believed that fevers, especially diarrheal fevers, were likely to be followed by cardiac symptoms. The experience is, I believe, general that after acute infectious diseases it is not uncommon to find that the rate of the heart remains elevated; it is frequent in acute rheumatic fever; it is true sometimes in lobar pneumonia, in tuberculosis and in typhoid fever. It is said to have been not uncommon after trench fever, and, according to Bridgman, in influenza. Tachycardia in the convalescence from these diseases is on occasion associated with pain and shortness of breath; it is almost a rule that patients are for some time after recovery from the infection unable to work as well as before. If the attempt to work is made the sense of fatigue or more uncomfortable sensations still soon terminate the effort. When the cardiac symptoms are accompanied by nervous phenomena the nervous symptoms may be regarded as being super-added to the cardiac ones and the two together taken to represent an occurrence apart from convalescence. It is doubtful whether nervous symptoms such as are seen in the Effort Syndrome, the name used to designate the Irritable Heart in the Expeditionary

¹⁵ Ueber Herzerkrankungen bei Kriegsteilnehmern, Verhandl. d. a. Tagung. d. Kong. f. inn. Med. in Warschau, 1916, pp. 50-67.

¹⁶ Loc. cit.

¹⁷ Loc. cit.

Forces, are common under these circumstances. There should be no difficulty in recognizing this condition. It runs a more or less definite course and ends in recovery.

Convalescence from an acute infectious disease assuredly cannot be urged as the cause of irritable heart, when, as happened in so many cases, there had been no infectious disease. Nor even if there has been an infectious disease like trench fever can this be said to be the cause of the Irritable Heart when a similar convalescent state is found following other infections. The heart in convalescence after acute infectious diseases and the Irritable Heart are probably not the same thing.

3. To distinguish the Irritable Heart of soldiers from the hyperthyroid heart presents genuine difficulties, for there are similarities between the two conditions. In both the rate is rapid, the size of the heart often greater than normal, abnormal sounds dependent on the rapid rate and on overaction are likely to be present and a shake or tremor of the extremities is common. There may be diarrhea; there is exophthalmos or the semblance of it. The similarities between the two conditions must be admitted, but there are grounds for disbelieving that patients suffering from the Irritable Heart are cases of hyperthyroidism. In the first place there is no genuine exophthalmos, but the look of anxiety which often gives the appearance of prominence to the eyes. Then in many soldiers who live near the Great Lakes or in the northern tier of States a thyroid tumor has been found. It has indeed been shown by McNee and Dunn in the British Army that the thyroid gland was heavier than normal in 65 healthy men killed in action. The weight given by them is 26.7 gm. Weighing the gland, they contend, shows the presence of enlargements not indicated by physical examination. These tumors are, however, as often present, as Addis and Kerr¹⁸ have shown, in men who have not the Irritable Heart. The tremor of Graves's disease is not found, but instead there is a coarse shake, the excursion of which increases while attention is given to it. The rate of the heart is not continuously high but falls during rest and sleep. If in Graves's disease the heart and the breathing attained rates as high as in the Irritable Heart, it is almost certain that during rest and sleep the high rates would be maintained and the breathing would be carried on with difficulty. In point of fact the situation is different in the Irritable Heart. During rest and sleep the rates of breathing and of heart-beat fall to normal. Peabody, Wearn and Tompkins¹⁹ studied at U. S. General Hospital No. 9 the basal metabolism of 57 cases, in 24 of which the diagnosis of hyperthyroidism had been made by competent observers. In

¹⁸ The Relative Frequency in Recruits with and without Thyroid Enlargement of Certain Signs and Symptoms Which Occur in Neurocirculatory Asthenia, *Arch. Int. Med.*, 1919, xxiii, 316-333.

¹⁹ The Basal Metabolism in Cases of "Irritable Heart of Soldiers," *Medical Clinics of North America*, 1918, ii, 507-515.

none of them was the metabolism above normal, whereas the usual high rate of 60 and 61 was found in 2 true cases of Graves's disease. The problem was studied also by Lewis and his associates, who failed to find a reason for assuming a relation between the two disorders. Although the two conditions have resemblances there is reason for doubting their identity. That malfunction of the thyroid gland may underlie the condition we call the Irritable Heart is a subject still open to investigation. It may produce these signs and symptoms by continuous or by intermittent activity in response to psychic stimuli or to stimuli arising within the body. For the present it is important to lay stress on the fact that the specific knowledge so far accumulated fails to bear out this contention.

It should now be clear that in the Irritable Heart of Soldiers symptoms and signs occur which resemble signs occurring also in convalescence from infections in chronic heart disease and in Graves's disease. But it should be understood that these signs may appear without having a relation to any of these diseases.

On account of the view in which this disorder was held before the war, especially on account of the influence Da Costa had on the subject, these cases were taken to lie in the field of cardiovascular diseases. It has therefore been my purpose to show that in the usual sense there is no abnormality of the heart, nor is the correction of the disorder amenable to methods usually employed in the treatment of heart disease. Indeed, the interest of patients so suffering may be better served at the hands of physicians trained to understand affections of this nature. The point may in fact be raised whether the improper conception has not been productive of harm in individuals who have been treated for heart affections when treatment should have been directed to a neurosis, not only the patient but also the army being sufferers by the mistake.

4. It remains, then, to show on what grounds the view is founded that this symptom complex is neurotic. There are, it is agreed, cases in large number presenting cardiovascular signs and symptoms which it is desirable not to group with those well-defined diseases that have just been discussed. Besides the cardiovascular symptoms of which they complain, it is generally admitted that the patients make that impression of nervousness to which former observers have given attention, even though emphasis has not been laid on this phase of this malady. The nervousness is of the variety already familiarly classed in states of anticipation and anxiety neuroses. The facies is significant of this state; the brow is furrowed; the eyes are troubled; the mouth is drawn. The reaction to unexpected noises is prompt and exaggerated. There is marked shakiness of the hands, limbs, body and head. There is absence of mucous membrane reflexes and exaggeration of the tendon reflexes. There is a tendency to insomnia and to disturbing dreams.

Neurologists and neuropsychiatrists have, during the war period, had plentiful opportunity of studying such cases. Mott²⁰ called them examples of neurasthenia. He says the men "complain of the usual symptoms of neurasthenia—viz., tremors, fatigability by mental and bodily effort; loss of consciousness and irresolution; hyperesthesia, paresthesia and pains which they consider to be rheumatic; fainting attacks; precordial pain and palpitation; feeling of dizziness; insomnia and dreams; loss of appetite; headache and gastric troubles." Salmon,²¹ McCurdy,²² Schwab²³ and others have uniformly interpreted them as cardiac manifestations of the neuroses.

But it is not only the cardiovascular symptoms which have caused difficulty in classification. Gastro-intestinal complaints depending on similar associations have, without doubt, been attributed in the army, as they have been sometimes in civil life, to incorrect causes. Musser,²⁴ for instance, has shown that in the examination of the gastric contents of frank Effort Syndrome cases after the ingestion of a test-meal the acidity continues to rise long after it has returned to normal in control cases. But of great interest are the respiratory complaints which have appeared especially after exposure to deleterious gases. Respiratory distress when associated with the symptoms of Disordered Action of the Heart has been studied especially by Barcroft, Hunt and Dufton²⁵ and by Haldane, Meakins and Priestley,²⁶ and a specific pathology underlying these symptoms has been suggested by them. In their conception the late stages of gas-poisoning present a chain of symptoms comparable to those arising from oxygen want in mountain sickness. Strauss²⁷ saw at Mesves many gassed soldiers who suffered from nocturnal asthma, and he supposed that an abnormality existed over and above a nervous state. There is rapid and shallow breathing, due, according to Haldane, Meakins and Priestley, to exaggeration of the Hering-Breuer reflex. The exaggeration is said to originate in the irritation of the lung tissue after injury inflicted by gassing, "or else by causes acting more generally on the nervous system." Anoxemia follows on this disturbed mechanism and is accompanied by the symptoms of oxygen lack. Polycythemia, first described

²⁰ War Psychoneurosis, *Lancet*, 1918, i, 127-129.

²¹ War Neurosis, National Committee for Mental Hygiene.

²² War Neurosis, *Psychiatric Bull.*, July, 1917.

²³ The War Neuroses as Physiologic Conservations, *Arch. Neurol. and Psychiat.*, 1919, i, 579-635.

²⁴ Personal Report to the Senior Consultant in Cardiovascular Diseases.

²⁵ The Treatment of Chronic Cases of Gas-poisoning by Continuous Oxygen Administration in Chambers, Reports of the Chemical Warfare Medical Committee No. 4.

²⁶ Investigations of Chronic Cases of Gas-poisoning, Reports of the Chemical Warfare Medical Committee No. 11.

²⁷ Personal Report to the Senior Consultant in Cardiovascular Diseases.

by Hunt and Price Jones,²⁸ is also present. Barcroft, Hunt and Dufton have shown that treatment of their thirteen patients in a chamber supplied with 40 per cent. of oxygen is followed by relief of the respiratory symptoms and a reduction of polycythemia, temporarily, at least, takes place. This is apparently not true of effort syndrome patients who have not been gassed.²⁹ Unfortunately, also, it has been impossible to study similar cases in the American Army. Medical officers not only in the Expeditionary Forces but also in this country, through the Surgeon-General's Office, were requested to report them on their own account, and because it was supposed they might become important from the viewpoint of war-risk insurance. Cases of cyanosis, bronchitis and asthma have been seen, but their identity with the British cases has not been established. In any case their number is small, but proper leisure and proper facilities for detecting and studying them have not been available.

There is this further group of cases: Many men who were gassed have been examined since the end of the war, and although they no longer complain of respiratory symptoms, and although physical examination and examination by roentgen rays fail to show that a pulmonary abnormality exists, and although their hearts appear to be sound, they complain still of pain in the chest, variously distributed, arising especially on exertion. They complain, moreover, of shortness of breath on exertion, the nature of which, on such careful examination and testing of functional ability as I have been able to make, is quite unclear.

With these facts in view it is striking that in reports by Strauss,³⁰ Levine³¹ and White³² and others the greatest number of cases of the Effort Syndrome occurred among men who were gassed. Strauss especially reported a large number of cases suffering from respiratory symptoms. St. Lawrence³³ studied the effort syndrome cases at the special training battalion, maintained for orthopedic cases at St. Aignan. He found that 9 of 17 cases reporting sick on account of these symptoms were gassed. Of 1500 other cases at the camp, 65 gave a history of gassing, and most of them gave some evidence of the Effort Syndrome of a mild type. The striking thing is that no cases other than those of gas origin showed symptoms sufficient to require report at sick call. "It was interesting to find," says St. Lawrence, "that a neurologist working beside, but independently

²⁸ A Note on the Later Effects of Poisoning by Asphyxiating Gas, Reports of the Chemical Warfare Medical Committee No. 15.

²⁹ Barcroft, J., Hunt, G. H., Dufton, D.: Treatment of Patients Suffering from "Effort Syndrome" by Continuous Inhalation of Oxygen, Reports of the Chemical Warfare Medical Committee No. 12.

³⁰ Loc. cit.

³¹ Personal Report to the Senior Consultant in Cardiovascular Diseases.

³² Ibid.

³³ Ibid.

of me, classified practically the same men as war neuroses." These officers assumed no special pathology for these cases. A reason for the occurrence of the Effort Syndrome symptoms in the gassed is in fact difficult to assign. It has occurred to me that an explanation may be supplied in this fashion. It is known that in the early part of the summer of 1918 gas discipline was not exemplary. Later, for that reason, the immediate and subsequent dangers from gas poisoning were emphasized to such an extent that it is not unfair to say a gas-phobia was developed. Possibly the unequal effect of gas on different individuals added to this attitude toward it. Men, for instance, who were apparently similarly exposed suffered in very unequal degrees. The recollection of these facts during hospitalization may have had an important bearing on the development not only of cardiac but also of respiratory symptoms. The respiratory cases are said to be due to exaggeration of the Hering-Breuer reflex occasioned by an irritative lesion of the lungs, but it is also said that "causes acting more generally on the nervous system" may be at fault. This suggestion, made by Haldane, Meakins and Priestley, is of special interest, for it may be that in their cases the derangement of the Hering-Breuer reflex brings about a disorder of respiration in the same sense that derangement of the vasomotor and cardio-inhibitory centers brings about Irritable Heart of Soldiers, both conditions being expressions of a neurosis. The number of men affected in this manner must in any event be few; 90 per cent. of all the gassed probably return promptly to duty. This was true in the British Army for the Boulogne district.²⁴ And of the remainder these considerations apply to a small number only. It is to be hoped that further light on this subject may be shed by studies pursued by the method of exact investigation.

That there are still other ways in which men suffer, aside from symptoms referable to the cardiovascular, gastro-intestinal and respiratory systems, is well known. The musculoskeletal system was frequently the method of expression of the neurotic state. This form is familiar in aphonia and in contractures and has been abundantly described in the neurological literature. I desire merely to point out that these are probably other manifestations—other expressions of a similar psychic mechanism.

It seems scarcely necessary to dwell on the reasons for the occurrence of anxiety states in the war. Descriptions of its terror were sufficiently familiar, so that an anticipation of what he might experience was lively in the mind of the least instructed recruit. This anticipation was operative in British recruits in England, we are told, as well as in the United States. It is, of course, clear that men vary in their behavior in the anticipation of such expe-

²⁴ Elliott quoted by Meakins, J. C., and Priestley, J. G.: Reports of the Chemical Warfare Medical Committee No. 16.

riences. We recognize the timorous and the hardy. That the timorous had a lively antagonism to leaving the United States on such an expedition need surprise no one. Such men were plentifully seen. Whether their dislike for adventure of this kind be attributable to constitutional inferiority, to race or to other causes is a matter of interest. It has been shown by Wolfsohn³⁵ and by Oppenheimer and Rothschild³⁶ and by Campbell³⁷ that heredity and previous personal history are significant factors in those men who are the first to fall out showing the symptoms of the Effort Syndrome. The mechanism of inferiority of this type is an important study. A difficulty with all these investigations is that they fail to consider the behavior of those men of similar family and personal history who managed to endure successfully the hardship and anxiety of war. Nor does it suffice in a study of this nature to assign a reason for failure in the case of the men who failed first and to dismiss the subject with the discovery of these so-called inferiors. The literature of the neuropsychiatrists contains the histories of many men who entered the war in the class of the hardy, and who, in the end, failed as the timorous failed in the beginning. It requires little imagination to understand the influence the sights and sounds and the experiences of actual warfare must have had gradually to wear down the endurance of the most resistant; for this reason many of the hardy failed. No doubt many men passed through the war psychically untroubled. But no doubt, also, it would have been difficult at the beginning to predict which men were likely to endure. Men the least likely may have succeeded; men the most likely may have failed. Men may indeed all be regarded as being vulnerable in this regard. The timorous naturally succumb first. They are often those who had already suffered from the wear and tear of life when the war began. The war itself supplied wear and tear, and as the hardier suffered, they, too, were worn down; they too, succumbed. There is involved, then, from this point of view not one factor, native predisposition, but two, native predisposition and time. That after four years of war, men as unlikely for service as any that were seen in our cantonments were numerous in the British Army, anyone who saw the cases at Colchester can testify. It may be said that the time factor applies only to the hardy, and this may be true. But no report has taken into account the successes of the less hardy and of the timorous—and, unquestionably, there have been many such. Taking constitutional predisposition into account is essential, but as a complete account of failure it appears to be inadequate.

³⁵ The Predisposing Factors of War Psychoneuroses, *Lancet*, 1918, i, 177-180.

³⁶ The Psychoneurotic Factor in Irritable Heart of Soldiers, *Jour. Am. Med. Assn.*, 1918, lxx, 1919-1922.

³⁷ The Role of Instinct, Emotion and Personality in Disorders of the Heart, *Jour. Am. Med. Assn.*, 1918, lxxi, 1621-1626.

This view suggests the reason for a difference in the nature of the cases seen here and seen in France. The difference was apparent to numerous observers. Here the undoubtedly timorous floated to the surface directly, were recognized immediately and were eliminated. This type became well defined. They were the constitutionally predisposed, the timorous. There reached France those of this group with more of reserve and these no doubt fell first there. But, on the whole, the bearing of those who came to France was better and the general impression they made superior. This difference accounts for the distinction that has been made between the classes seen in the two places.

Other facts bear on the probability that the symptoms of Irritable Heart depend on a neurosis. The symptoms were all but unknown in the severely wounded. The faces of these men were turned definitely away from the front. The same may be said of the severely gassed. And it is commonly admitted that prisoners of war were quite free from such ailments. All these men were finished with the war. It was most striking that in the week following November 11, 1918, the day of the signing of the Armistice, it became difficult, while travelling, as I undertook to do, among the Base Hospitals, to find the cases which had been so frequent. Their number diminished, practically disappeared, except for the more severe types. The same observation was made in respect to the musculoskeletal cases, the so-called functional joint cases. At Base 117, the neuropsychiatric hospital, special precautions were taken lest the disappearance of symptoms receive tactless comment, with subsequent injury to the patients. It is not the intention, however, to contend that no cases were seen after this time. Reasons for the presence of Irritable Heart cases, perhaps as numerous as in civil life, remained, and there were added other reasons for their occurrence as well. A similar situation prevailed among the neuropsychiatric cases.

The outlook for the cases of Irritable Heart depends on the conception one has of their nature. If, in essence, they depend on malfunction of the thyroid gland or on malfunction or hypertrophy of the heart in Da Costa's sense, their future will be foretold as that of these conditions. But if the symptom complex is regarded as a neurosis, there is, with suitable treatment, reason to think that recovery will take place in all but the severe cases. Hume,³⁸ for instance, returned the cases after four weeks. In an army it is, however, not enough to return men to the front; unless they are genuinely fit for duty, they retard rather than help the work of their organizations. There are available statistics such as Lewis's and Bridgman's to show what the result of treatment has been. It is, however, important to have records on a greater scale.

³⁸ Loc. cit.

Viewed as a neurosis, then, the outlook for a rapid recovery is favorable. But if the view of Da Costa is taken, of the possibility of a functional derangement of the heart passing into an organic, a hypertrophic one, the difficulty of prognosis is greater. For here, so far as service is concerned, the soldier ought probably to be discharged and his future viewed with uncertainty. Herein is involved the question of the size of the soldiers' hearts, of which mention has already been made.

Treatment similarly awaits a decision on the nature of the disorder. Here, too, Da Costa had definite views. He put patients to bed to rest and he gave them drugs—digitalis, aconite, atropin—which he believed did good, each for a different phase of the malfunction of the heart. The effect of a number of drugs has been tried by Parkinson³⁹ and others during this war at Colchester. It may be said, in brief, that these were without benefit. Graduated exercises were introduced by Lewis, both to sort men with a view to determining their class of service and also to ameliorating their symptoms. There can be no doubt that, so far as classifying is concerned, the introduction of the graduated exercises was a work of signal usefulness, and giving them prominence had important results. It would, however, be ungracious to fail to recall that Da Costa made use of a similar method. It is another matter, however, whether the exercises are of benefit at the root of the malady. If Irritable Heart is a neurosis based on anxiety it is clear that exercises conducted by a drill sergeant do not meet the therapeutic indication. It is doubtful whether strength can be supplied in this manner, especially when one considers that in anxiety and fear strength ebbs—strength being then a neurological not a muscular function. It may be that the James-Lange law is applicable in this connection—that one is anxious because one's strength has fled. Into this discussion we cannot enter. But so much it has been necessary to mention to indicate the inadequacy of graded exercises as a therapeutic measure.

In the Expeditionary Forces we were led, after reflection, to adopt the view that the Irritable Heart of Soldiers was the expression of a neurosis. It was for that reason that the chief surgeon was prevailed upon to abandon the designation "Disordered Action of the Heart" (D. A. H.), borrowed from the British. For that reason, also, no term was recommended in substitute in which any organ or system of organs in the body was mentioned. It was thought a term so constructed would have unfortunate consequences, both for the individual and for the army. The term *Effort Syndrome* was borrowed from Lewis for several reasons: We could devise no better one; it avoided the difficulty of others already or formerly

³⁹ Parkinson, J.: *Digitalis in Soldiers with Cardiac Symptoms and a Frequent Pulse, Heart*, 1915-17, vi, 321-336.

in use; its choice was a recognition of the great service Lewis had done in bringing prominence to the subject. That we came in the end to ascribe to the term a different meaning from the one he gave to it was of small consequence; for while he thought of the affection as a syndrome resulting from effort—from any effort, in fact—we thought of it as one developing, under special circumstances, from a peculiar effort, the unusual effort demanded by the war and the unfamiliar stimuli associated with it.

The disorder having been studied and the name of the disorder having been selected, we addressed ourselves to making recommendations for the care of the patients. In this we availed ourselves of the experience of the British, who, in many respects, had attained, it seemed to us, conspicuous success. The most important advice the British gave us related to the location of convalescent camps for their reception. The British thought, and experience showed, that the camps should be built as far as possible away from the hospitals—five, ten or fifteen miles. Our convalescent camps, however, formed an integral part of the great hospital centers. The immediate effect of this was to impair the morale of the convalescent camp and to prevent the introduction of suitable therapeutic measures, because on account of the necessarily rapid rate of growth, convalescent soldiers were utilized as labor and construction troops. It is possible and even probable that the men did not suffer under this system, but it prevented an attempt at systematic therapeutic supervision by medical officers. And it was not only impossible for medical officers properly to fulfil their functions, but being untaught in work of this nature it prevented their acquiring necessary experience.

The location and administration of the camps were then, during the war period, unsatisfactory. Whether time, had the war gone on, would have improved this situation it is impossible to say. It is a pleasure to record, however, that those of our medical officers who were especially trained by Lewis and others for this work were unusually faithful, remained cheerful under strikingly trying circumstances and could not have failed in the end to accomplish noteworthy results.

For the soldiers the camp, as the British designed it, had a specific work to do. It was to give him back his morale, his cheerfulness and his courage. He should emerge from the camp ready to undertake his share of the burden willingly. It cannot be said that we made any important contributions to the technic of managing the soldiers. We were learning when the war ended and were meanwhile availing ourselves of the experience of the British. They taught us first that there was necessary in the camp an attractive atmosphere. The barracks or huts must be well arranged and laid in grounds well cared for and landscaped. Surprising results in gardening are possible in France in a year. The soldiers,

divided in companies and battalions, were kept on a modified but strict discipline. They were instructed and amused, or, preferably, they were taught to amuse themselves. There were setting-up exercises, marches with the band; there were round games and tennis, golf and cricket; athletic competitions, lectures and picture shows. Auxiliary agencies were welcomed; the Red Cross, the Y. M. C. A. and as many more as had entertainment to offer. There were theatricals, often arranged by the men themselves; these last longer and stimulate more interest than those supplied to them. And there was plenty of music; in one British camp there were two brass bands, an orchestra, a mandolin and a banjo club. And there are many other ways of keeping the men entertained and of resupplying enthusiasm for an experience undertaken none too eagerly. Presiding over the whole were the medical officers, especially selected for this difficult and important salvage work, under whose immediate direction the work went on, the detailing for exercises and games, the graduation for fitness from class to class. With this system results were obtained. Many a soldier returned to his work uplifted in mind and in spirit, cheerfully willing to make his sacrifice afresh. It is a mistake, however, to suppose that the British acquired their camps full-blown; one commanding officer told me that the acquisition of every single piece of wood in the place represented an argument. But it was to a system like theirs to which we looked forward, and which, no doubt, we should have approached this summer had not the war fortunately cut short our career.

For civil practice this experience has a lesson. There are many unfortunates who fall into this group of patients. It will not be seriously contended that the practice of medicine has adequately studied or solved the problems connected with this phase of disease. There are problems in pathogenesis, problems in the mechanism of the disorder, problems in therapeutic organization awaiting solution.

In this paper it has been the special purpose to point out milestones in the history of this subject. Da Costa first defined it; on the basis of his work the study continued in this war. In his view the disorder arose most often as the result of infectious diseases, was most likely a functional disorder, going on to organic change in the heart, and was certainly affected beneficially by drugs. The symptoms which he described, and which we recognize, are alike. We differ from him in that we think that no matter what the predisposing cause, whether it be infectious disease, malfunctioning glands of internal secretion or gas-poisoning, the disorder is essentially a neurosis, depending on anxiety and fear; that it is removed by the disappearance of the exciting cause and that it is cured by measures designed to influence the neurotic state.

A LONG DURATION OF REMISSION IN PERNICIOUS ANEMIA.¹

BY CHARLES G. STOCKTON, M.D.,

BUFFALO, N. Y.

IN his article on "Pernicious Anemia," in Osler's *Modern Medicine*, Richard C. Cabot recounts 2 cases having a remission lasting four years and a doubtful instance of six years. This author also has records of 37 long cases, that is, continuing more than four years; 3 of these lived fourteen years. This list includes 6 cases, which Cabot considers as definitely recovered.

I have to report a case first seen in 1899. It was in all respects a typical case, as the accompanying report of the blood count indicates:

OCTOBER 11, 1900.

Number of red corpuscles per centimeter	1,021,300
Number of white corpuscles per centimeter	3,250
Percentage of hemoglobin (Dare)	26.0
Color index	1.3

Red cells.	White cells.
Normoblasts, none	Polynuclears 60 per cent.
Intermediates, none	Small lymphocytes 34 "
Megaloblasts, two	Large lymphocytes 4 "
Microblasts, none	Transitional 0 "
Poikilocytes, large number	Eosinophiles 1 "
Microcytes, large number	Basophiles 0 "
Macrocytes, none	Myelocytes 1 "
Stippling, none	Eosinophilic myelocytes 0 "

There was an irregular improvement for six years, at which time, although there was a moderate anemia, the blood lost all characteristics of the pernicious type. To convey some idea of the course of the case during the earlier years the counts of the erythrocytes are given in order. The other characteristics of the blood kept in close ratio with the red count.

	Erythrocytes.	Hemoglobin.
December, 1899	2,444,000	60 per cent.
April, 1900	3,240,000	80 "
October, 1900	1,021,300	26 "
March, 1901	3,280,000	75 "
July, 1901	4,624,000	83 "
October, 1901	4,208,000	89 "
July, 1902	3,354,600	75 "
October, 1902	3,960,000	89 "
December, 1902	3,906,400	89 "
March, 1903	4,176,000	92 "
October, 1903	3,716,000	80 "
May, 1904	3,920,000	85 "
January, 1904	4,000,000	89 "
January, 1905	4,208,000	92 "
July, 1906	3,900,000	88 "
November, 1906	4,100,000	81 "
January, 1907	4,856,000	80 "

¹ Read before the Association of American Physicians, June 17, 1919.

In 1907 there were no abnormal cells found. The blood was in every way satisfactory.

As the patient was now discharged, and, although seen occasionally, was never examined as to her blood, it is impossible to state the precise condition during the intervening years. However, from 1907 until the beginning of 1918 the patient was considered to be well.

Then there was a sharp recurrence which soon became threatening. The case failed to respond to the action of atoxyl and sodium cacodylate, which drugs formerly had appeared to be of benefit. In February, 1918, the blood count was as follows:

Number of red corpuscles per centimeter	1,656,000
Number of white corpuscles per centimeter	2,700
Percentage of hemoglobin (Dare)	28 per cent.
Color index . . . . .	.8 "

Red cells.	White cells.
Normoblasts, 6 in 200 cells	Polynuclears 36.5 per cent.
Intermediates, 1 in 200 cells	Small lymphocytes 58.5 "
Megaloblasts, none found	Large lymphocytes 0.5 "
Microblasts, none found	Transitional 0.0 "
Poikilocytes, many	Eosinophiles 4.5 "
Microcytes, many	Basophiles 0.0 "
Macrocytes, great many	Myelocytes 0.0 "
Stippling, present	Eosinophilic myelocytes 0.0 "
Polychromatophilia, present	
Notes, four days before transfusion.	

A transfusion of 900 c.c. from the vein of her daughter led to temporary improvement, the count rising to: erythrocytes, 3,408,000, leukocytes, 3000. The gain was transient. A fortnight later the family physician, Dr. Hall, of Bradford, Pa., reported the blood count practically where it was before transfusion. A week thereafter the patient developed lobar pneumonia and died three days later, nearly twenty years from the recognition of her first attack of pernicious anemia.

This seems to show that although a patient may escape all signs of the disease (save one) for a period of ten to twelve years, yet the disease may recur.

I emphasize that there was the disappearance of all evidence of the disease save one. That one was the continuance of achylia gastrica. In a long series of cases, private and hospital, studied during thirty years, I have not found an exception to the rule of the presence, sooner or later, of achylia gastrica. In this series of cases there have been several long remissions, but never has the gastric function been restored.

This persistence of achylia gastrica may have more significance than has been accorded it in late years. If we grant that pernicious anemia is the expression of an infection, it is not improbable that gastric infection is in some way a link in the chain.

The belief prevails that an exceptional case of pernicious anemia goes on to recovery. Has anyone ever reported the restoration of normal gastric secretion? In view of the fact that in this case, so far as I know, the most promising on record, the disease recurred twenty years after its inception, and after having a remission in which there was to all appearances good health for a period of twelve years, I feel that it may be concluded that a patient probably never entirely recovers from pernicious anemia.

The persistence of the gastric lesion points to a close pathological relation between the stomach and the anemia. In this connection attention is called to the observations of Seyderhelm,² of Strassburg, working with larvæ of the fly *Estrus equi*, occurring in the gastric mucosa of horses suffering from a severe anemia, in its characteristics said to be suggestive of pernicious anemia in man. The bibliography of this work, copied from the *Journal of the American Medical Association*, vol. lxxii, No. 9, is hereto attached.

MENINGOCOCCUS ARTHRITIS.

BY W. W. HERRICK, M.D.,

ASSISTANT PROFESSOR OF MEDICINE, COLLEGE OF PHYSICIANS AND SURGEONS,
COLUMBIA UNIVERSITY, NEW YORK CITY,

AND

G. M. PARKHURST, M.D.,

NEW YORK CITY.

HISTORY AND LITERATURE. Osler,¹ in a clinical lecture on the arthritis of cerebrospinal fever makes mention of a treatise on "The Malignant Epidemic Commonly Called Spotted Fever," published by North,² of New York, in 1811, in which the author gives account of "swelling like rheumatism of the joints." This is apparently the earliest account of meningococcus arthritis. Osler also mentions a report to the Massachusetts Medical Society, dated 1810, by Thomas Welch, James Jackson and John C. Warren,³ in which it is stated that "in some cases (of spotted fever)

² Seyderhelm, K. R., and Seyderhelm, R.: Die Ursache der perniziösen Anämie der Pferde, Arch. f. exper. Pathol. u. Pharmacol., lxxvi, 149. Wesen: Ursache und Therapie der perniziösen Anämie der Pferde, Arch. f. wissenschaft. u. prakt. Tierheilkunde, 1914, 41; Experimentelle Untersuchungen über die Ursache der perniziösen Anämie der Pferde, Berl. tierärztl. Wchnschr., 1914, No. 34. Seyderhelm, R.: XVII Tagung der Deutsch. path. Gesellsch., 1914. Seyderhelm, R.: Ueber die Eigenschaften und Wirkung des Oestrius und seine Beziehung zur perniziösen Anämie der Pferde, Arch. f. exper. Path. u. Pharmacol., 1918, lxxxii, 253.

¹ The Arthritis of Cerebrospinal Fever, Collected Reprints, 4th series, 1897-1902.

² Treatise on a Malignant Epidemic Commonly Called "Spotted Fever," New York, 1811, p. 15.

³ Medical Communications, Dissertations of the Massachusetts Medical Society, 1813, ii, 135.

swellings have occurred in the joints and limbs. These have been very sore to the touch, and their appearance has been compared to that of gout. The parts feel as if they had been bruised. These swellings are in the smaller as well as in the larger joints and are often of a purple color. Those of the small joints especially soon disappear as the disease approaches its crisis."

In 1899, Gwyn⁴ reported a case of meningococcemia, with meningitis as well as polyarthritis, in which for the first time the meningococcus was recovered from the blood, cerebrospinal fluid and joint exudate of the same patient.

Cecil and Soper,⁵ in 1911, gave an account of meningococcus sepsis, with early arthritis without meningitis. More recently many French observers, among them Roger,⁶ Netter and Durand,⁷ Sainton and Bosquet,⁸ and Faroy and May⁹ have studied this complication of meningococcus infections.

Of the English writers, Osler¹⁰ Rolleston¹¹ and Still¹² have given attention to this condition.

FREQUENCY. Among 902 cases collected from various sources 6.5 per cent. had arthritis, and of 502 recent cases in the British naval forces the percentage of arthritis was 4.8 (Rolleston).¹³ Sophian remarks that this complication occurs in 10 to 15 per cent. of cases of meningococcus meningitis; Roger's figures are 5 to 20 per cent.; Osler¹⁴ found it in 2 of 21 cases, Councilman, Mallory and Wright,¹⁵ in 6 of 111 cases.

Accounts of postmortem study of the joints of meningococcus arthritis are meager. Still¹⁶ found the joint lesions complicating the posterior basic meningitis of infants exclusively peri-articular. Osler considers the inflammation peri-articular as a rule and has described a case of mixed infection with the staphylococcus. The majority of students have found the rather viscid, often somewhat gelatinous exudate at times with blood and with a

⁴ A Case of General Infection by the *Diplococcus Intracellularis* of Weichselbaum, Bull. Johns Hopkins Hosp., 1899, x, 112.

⁵ Arch. Int. Med., 1911, viii, 3.

⁶ Pyarthrose ankylosante du genou et de la hanche au cours d'une méningite cérébrospinale, Marseille méd., 1918, L. V. 505-516.

⁷ Les arthrites suppurées à meningococciques, Bull. de l'Acad. de méd., Paris, April 13, 1915, lviii, 441.

⁸ Arthrite méningococcique de l'épaule à forme plastique ankylosante. Manifestations pulmonaires et méningite consécutives. Arthrite du Genou Post-Meningitique, Soc. méd. des hôp. de Paris, March 17, 1916, 3d series, p. 344.

⁹ Bull. et mém. d. l'hôp. de Paris, 1919, No. 3, 3d series, liii, 44.

¹⁰ The Etiology and Diagnosis of Cerebrospinal Fever, British Med. Jour., 1899, i, 1521.

¹¹ Lumleian Lectures on Cerebrospinal Fever, Lancet, April 19, 1919, No. 4990, Lecture III, cxvii, 645.

¹² Simple Posterior Basic Meningitis in Infants, Jour. Path. and Bacteriol., London, 1898, v, 147. See also Longo, A.: *Pediatrics*, 1917, xxv, 321; abstracted in Jour. Am. Med. Assn., 1917, lxi, 322.

¹³ Loc. cit.

¹⁴ Report of Massachusetts State Board of Health, Boston, 1898.

¹⁵ Loc. cit.

¹⁶ Loc. cit.

variable number of polymorphonuclears, in rare cases sufficient to form a thick greenish pus. Meningococci are not found as a rule. Most writers believe they disappear early. Experience has been almost universal that the joint exudate is completely absorbed and that no sequelæ persist. Sainton and Bosquet¹⁷ and Roger,¹⁸ however, have cited cases in which ankylosis of the knee, hip or shoulder has followed meningococcus arthritis. In one case the radiograph showed "rarefaction of the bone adjacent to the epiphysis." We have observed one case of necrosis of the head of the radius following meningococcus arthritis of the wrist. The meningococcus was not isolated from this lesion at operation.

In a study of an epidemic of 321 cases of meningococcus infection at Camp Jackson, N. C., from November, 1917, to April, 1919, we have been impressed with the frequency of arthritis, with the variety of its manifestations and with the clinical profit of a separation of these arthritides into different forms or types. The result of our studies has been the classification of these varieties of arthritis met with in meningococcus infections, which we here present.

Arthritis in meningococcus infection may appear in three forms or types, each having peculiar significance in diagnosis, prognosis and treatment. For convenience we shall speak of these as "Type A," "Type B" and "Type C."

As "Type A" we designate an acute polyarthritis that is frequently the initial symptom, more often one of a number of symptoms of onset, and that does not, except in rare cases, appear later than the first, second or third day of the disease. This type is a feature of many of the cases with severe infections and is usually a harbinger of a stormy course. Almost all these cases have profuse hemorrhagic rashes coincident with the polyarthritis. In many but not in all instances the arthritis is as transitory as the rash. It would seem that these early joint symptoms are due to hemorrhage into the articular and periarticular structures, especially the synovia and are identical with the hemorrhagic lesions of the skin and serous membranes.

The clinical picture is not unlike that of acute rheumatic polyarthritis. Symmetrical joints are usually involved—the wrists, knees, ankles and elbows; less often the hips, shoulders and small joints of the hands. Pain on motion is great, as is tenderness. Effusion is slight, more often absent; in no case has it been enough to aspirate. Other complications of meningococcus sepsis, such as panophthalmitis, epididymitis and pericarditis, are very frequent. Meningitis is not always present. The usual duration of this type of meningococcus arthritis is from one to six days, excep-

¹⁷ Loc. cit.

¹⁸ Loc. cit.

tionally longer, even six weeks. Some of these prolonged cases may merge with the second form, "Type B," to be described.

STATISTICAL SUMMARY OF CASES OF MENINGOCOCCUS ARTHRITIS, "Type A." In an epidemic of 321 cases there were 12 examples of this early acute polyarthritis which we designate "Type A." Of these 8 lived and 4 died, the mortality being 33.3 per cent. Arthritis was the initial symptom in 3 cases; the symptom of the first day of the disease in 3 cases; a symptom of the second day in 1 case and of the third day in 1 case. The wrists were involved in 8 cases, the knees in 7; the elbows in 3 and the ankles in 3; the shoulders in 1 and the hips in 1; the small joints of the hand in 1; "all joints" or "many joints" in 3. There is note of rash in 10 of the 12 cases. Of these 10 cases 9 had the petechial or punctate hemorrhagic rash, 1 had the maculopapular type, while 2 had purpura combined with petechiæ. Positive blood culture was noted in 3 cases.

Of these 12 cases 5 had panophthalmitis, with destruction of the globe, 2 hydrocephalus; 2 epididymitis and 1 gangrene of the skin. Two of the 12 cases did not develop meningitis. Of the recovered cases 5 had the combined intraspinal and intravenous serum treatment, 2 had intraspinal and 1 intravenous treatment only. Of the 4 fatal cases, 2 had only intraspinal serum treatment, 1 had combined intraspinal and intravenous and 1 intravenous treatment alone. Cases receiving only intravenous treatment were those in which meningitis was absent.

ARTHRITIS "Type B." The second type of arthritis which we designate "Type B" is differentiated from the preceding type quite sharply. Its onset is late, usually about the fifth day. With few exceptions only one joint is affected, generally the knee, occasionally the ankle, hip, shoulder, wrist or elbow. In contrast to "Type A," effusion is a prominent feature, so that aspiration of the synovial capsule is suggested in many cases. Swelling is great, but redness, pain, tenderness and limitation of motion are surprisingly slight. Often a tensely swollen knee-joint can be manipulated freely, with only moderate discomfort. In no other acute arthritis is there this striking disproportion between the swelling and the other inflammatory signs. The exudate is usually viscid, mucinous, semipurulent, not infrequently hemorrhagic, containing pus cells numbering from 1000 per cm. to uncountable numbers. Rarely there is thick greenish pus. Meningococci are found in at least one-third of the cases. The organisms are quite as often extra- as intracellular. Systemic disturbance in the form of moderate fever is generally present. The duration of the process is usually from one to four weeks, recovery being gradual, but complete. Rarely stiffness and slight pain or muscular spasm remain for a long time.

The prognosis of the late monarthritic form is good. In our experience only 12.5 per cent. of these cases died. This is in contrast with the 33.3 per cent. mortality of "Type A" cases. It

may be that the focus of the infection in a single large joint acts as a fixation abscess and as such elaborates antibodies which play a part in establishing immunity.

The cases which we designate "Type B" numbered 16. Of these 14 recovered and 2 died. The mortality, therefore, was 12.5 per cent. The right knee was involved 7 times, the left 7; both hips, both ankles and both wrists, once each and the right shoulder once. Of the 3 cases having more than one joint involved, 2 had both knees and 1 the left ankle and right wrist.

The onset of arthritis in 1 case was on the second day, in 3 cases on the third day, in 3 on the fifth, in 2 on the sixth, while the remaining 6 cases showed arthritis on the ninth, eleventh, thirteenth, seventeenth, eighteenth or twenty-second. In 8 of these 16 cases a joint was aspirated. Of the joint exudates 4, or 50 per cent., showed meningococci. There is record of positive blood culture in only 1 case, but unfortunately the records on this point are incomplete.

The arthritis lasted two days in 1 case, one hundred and three days in another, the average duration of joint symptoms being about fifteen days. Recovery was complete in all cases but one. In this instance there was persistent muscular spasm with fixation of a knee-joint in semiflexion, requiring orthopedic treatment.

Among these 16 cases other complications were relatively rare. Panophthalmitis occurred once, epididymitis 3 times, hydrocephalus twice, pneumonia and pericarditis once and gangrene once. Of the recovered cases 2 were treated by the intraspinal method, 8 were treated by the combined intraspinal and intravenous methods and 1 was treated by the intravenous method alone. The 2 fatal cases were treated by the combined method.

ARTHRITIS "Type C." The third type of arthritis, "Type C," which may be met in meningococcus infection, is the well-known serum arthritis. This does not differ from the serum arthritis seen after serotherapy in pneumonia or other acute disease. No description is called for here. It is of interest that this sequel of serum administration appears to be quite as common after intraspinal serum treatment as after combined intraspinal and intravenous methods. In our series of 321 cases there were 12 examples of serum arthritis, of which 6 were treated by each method.

The characteristics of the three types of arthritis are set forth in tabular form in Table I.

"PURPURA RHEUMATICA" AND MENINGOCOCCUS SEPSIS. During a consultation visit to another base hospital one of us (W. W. H.) had opportunity to observe the following case:

A soldier was admitted to the hospital, March 6, 1918, giving history of an attack of tonsillitis a few weeks before, since which he had not been well. Malaise and lack of strength and energy were constant. On admission there was great soreness of the muscles and joints, a hemorrhagic eruption and a temperature of

101°. A diagnosis of purpura rheumatica was made. During the next ten days several internists, a neurologist and a dermatologist concurred in the diagnosis. Moderate polyarthrititis with purpuric spots, more numerous about the joints, continued without meningeal symptoms until March 14, when there was note of headache and neck stiffness, which subsided. Not until March 21 was lumbar puncture done. The cerebrospinal fluid was under great pressure and contained pus and meningococci. The blood culture was negative. Combined intravenous and intraspinal treatment was given and complete recovery ensued.

Such cases, by no means infrequent, very properly call in question the group of arthritic purpuras. Is it not possible that many cases of purpura rheumatica or Schoenlein's disease have been unrecognized meningococcemias? Is it not possible that many cases of Henoch's purpura have been a meningococcus sepsis in which the organism has failed to respond to ordinary cultural methods? This group of hemorrhagic diseases with symptoms of infection needs further bacteriological study.

MENINGOCOCCUS ARTHRITIS.

Type of arthritis.	A	B	C
Time of occurrence.	At onset.	Several days (averaging five) after onset.	After sixth day.
Joints involved	Symmetrical polyarthrititis of wrists, knees, elbows, ankles; often almost all joints of extremities	One joint, usually knee	One or several.
Pathology . .	Hemorrhage into synovia or peri-articular tissues	Purulent arthritis.	Serous arthritis.
Bacteriology of joint exudate	Exudate not examined	Meningococci present in one-third of cases	Negative.
Pain . . .	Severe	Moderate	Moderate.
Redness . .	Marked	Slight or absent	Moderate.
Swelling . .	Slight or absent	Marked	Moderate.
Tenderness . .	Marked	Slight	Moderate.
Spasm . . .	Marked	Slight	Moderate.
Type of infection . . .	Severe, grave or fulminating	Mild or moderately severe	No relation.
Skin symptoms	Hemorrhagic rashes constant	Inconstant	Urticaria, erythema.
Duration . .	Short	Prolonged	Short.
Complications .	Panophthalmitis, epididymitis, etc.	Infrequent	Serum sickness.
Prognosis . .	Poor	Good	Good.
Treatment . .	General, largely serotherapy	Local, aspiration if indicated; local serum injections	Rest and time.

TYPE I.—ARTHRITIS.

M. F.—Herniotomy, May 7, 1918. Meningitis, July 8. Profuse petechial rash. July 9, redness, swelling, tenderness, pain in

right wrist. July 12, both wrists and left knee involved. Arthritis disappeared July 20. Serum: intraspinaly, 290 c.c.; intravenously, 505 c.c. Recovery.

J. S.—Onset, December 3, 1917, with malaise, tonsillitis and petechial eruption. December 5, meningitis. December 6, acute polyarthritis appeared, with redness and swelling of wrists, elbows and knees. Duration, forty-eight hours. Severe course. Serum: intraspinaly, 215 c.c.; intravenously, 105 c.c. Recovery.

O. C.—Admitted November 9, 1917, with measles. November 27 had acute polyarthritis following a chill. A profuse petechial rash appeared, also meningitis. The right shoulder and small joints of the left hand remained acutely painful, red and swollen for a number of days. Serum: intraspinaly only, 135 c.c. Recovery. Symptoms subsiding December 18.

S. C.—Admitted December 21, 1918, with severe type of infection and petechial rash and soreness and stiffness in many joints without effusion. Developed left panophthalmitis and parotitis. Serum: intraspinaly, 190 c.c.; intravenously, 75 c.c. Recovery.

J. C.—Admitted January 14 with a history of pain and aches all over for four days. A petechial rash was present. January 16, both wrists and right knee became swollen, red and tender. There was pain in other joints, but without tenderness or other signs. Developed panophthalmitis and acute hydrocephalus. Serum: intraspinaly only, 310 c.c. Death. Autopsy, No. 18-A34.

W. E.—Admitted December 18, 1917, with a gradual onset, after measles, of aching in arms, back and legs. On admission there was arthritis of the right elbow, both knees and both ankles. December 24 there was moderate effusion in the knees with swelling and tenderness. Bilateral panophthalmitis developed. Serum: intraspinaly only, 95 c.c. Death six days after onset. No rash was noted.

R. T.—Attendant in meningitis ward. Admitted December 26, with history of a cold in the head for three days. Marked petechial eruption present. December 27 developed an arthritis of the right ankle and left knee. Knee aspirated, no organisms found. Cell count in exudate 14,000. Developed panophthalmitis. There was a positive blood culture. Meningitis not present. Serum: intraspinaly, 0; intravenously, 600 c.c. (approx.). Death, February 13. At autopsy meninges normal. Last mention of arthritis January 8.

A. M. H.—Head nurse in meningitis ward. Tonsillitis, January 16, 1918. Sinusitis, January 23. January 25, acute polyarthritis began. There was only moderate stiffness, swelling, pain and tenderness in hips, knees, ankles, elbows and wrists. This soon subsided and the nurse returned to duty. February 11, the sinuses were drained with a trocar. This was immediately followed by chill, serious prostration, fever and severe polyarthritis. A maculopapular eruption was present. Blood culture, February 16, showed

meningococci. Intensive intravenous treatment was begun. In five days the symptoms disappeared. Returned to full duty April 1. No meningitis.

TYPE 2.—ACUTE MONOARTHRITIS.

E. S.—Admitted December 1, 1918, with severe meningitis. December 19, developed arthritis of both knees, with a purulent gelatinous yellowish exudate, containing meningococci. Panophthalmitis. No rash mentioned. Serum: intraspinally, 85 c.c.; intravenously, 75 c.c. Recovery.

E. S.—Following tonsillitis was admitted December 17, 1917, with severe type of infection, a petechial rash and panophthalmitis. December 22, developed arthritis of the left knee. A purulent fluid was aspirated. No organisms were found. Blood culture was not made. Serum: intraspinally only, 110 c.c. Recovery.

J. H.—Admitted October 13, with petechial rash and purulent meningococcus conjunctivitis, with corneal ulceration. Epididymitis. October 16, had arthritis of the right ankle, with swelling, redness and effusion. Phlebitis of the right-arm vein also present. No meningitis. Serum: intravenously, 230 c.c. Recovery.

L. McR. (colored).—Admitted October 11, 1918, comatose, in serious condition, with conjunctival petechiæ. October 20, purulent arthritis of the left knee appeared. October 24, 20 c.c. purulent fluid was aspirated showing large numbers of extra- and intercellular Gram-negative organisms. Serum: intraspinally, 100 c.c.; intravenously, 100 c.c. Recovery.

M. P.—Admitted May 28, 1918. A moderately severe infection, with erythematous and petechial rashes was noted. Arthritis of the left knee appeared June 2, with pain, tenderness and effusion and a small area of redness over the internal aspect. 70 c.c. of moderately purulent fluid were removed by aspiration. Meningococci were present. Recovery complete. Serum: intraspinally, 30 c.c.; intravenously, 365 c.c.

C.—Measles, July 15, 1918. July 25, developed meningitis of severe type with petechial rash. July 28, developed acute arthritis of the right wrist, which subsided in forty-eight hours. Bilateral parotitis. Serum: intraspinally, 195 c.c.; intravenously, 320 c.c. Recovery.

J. W.—Admitted, January 23, 1918, with a severe type of infection. February 4, showed arthritis of both knees. 60 c.c. straw-colored fluid aspirated from the left knee. February 7, 40 c.c. fluid aspirated from the right knee. No organisms found in joint exudate. Patient developed hydrocephalus and gangrene of the toes. Serum: intraspinally, 95 c.c.; intravenously, 600 c.c. Death.

W. W.—Admitted March 26, 1918, with petechial rash. March 29, there was effusion in the left knee, with pain and tenderness. Aspiration gave 35 c.c. of a semipurulent, yellowish-green fluid.

Serum was injected into the joint. The fluid showed a large number of pus cells but no organisms. The right hip became involved April 1, with much swelling. Arthritic symptoms lasted about four weeks. Serum: intraspinally, 135 c.c.; intravenously, 255 c.c. Recovery.

R. H. F.—Admitted November 17, with severe type of infection and petechial rash. November 22, arthritis of the left wrist, left ankle and right knee appeared, with much effusion in the knee-joint. Serum: intraspinally only, 130 c.c. Recovery.

L. R.—Admitted December 26, 1917, very ill with petechial rash. January 7, developed bronchopneumonia and pericarditis. January 9, an acute arthritis of the right shoulder. Epididymitis and acute hydrocephalus were complications. Serum: intraspinally, 365 c.c.; intravenously, 130 c.c. Death.

E. R.—Admitted February 6, seriously ill with petechial rash. February 8, had arthritis of the right knee. February 14, fluid in knee aspirated, 7 c.c. of yellow, cloudy fluid obtained, pus cells abundant, no meningococci. Serum: intraspinally, 90 c.c.; intravenously, 260 c.c. Recovery.

J. W.—Onset, December 4. Admitted to hospital December 5 in serious condition, with petechial rash and meningitis. Developed arthritis in right knee December 23. This cleared up largely by January 1. January 6, had recurrent arthritis, with meningococci in the exudate. January 7, examination of fluid of knee showed pus cells and a few extracellular meningococci. Serum: intraspinally, 135 c.c.; intravenously, 35 c.c. Recovery.

J. G.—Admitted November 28, 1918. A serious infection, with petechiae and purpura. December 4, arthritis of right knee developed; 50 c.c. of greenish-yellow pus was aspirated and 15 c.c. of antimeningococcus serum injected. There was a temperature from the arthritis, which cleared up December 13. Blood culture was positive. Serum. Recovery.

N. J.—Admitted December 17, in serious condition, with thickly set petechial rash. December 22, the right knee became tender and distended with fluid; 70 c.c. of yellow, oily, purulent fluid was aspirated, containing large sediment of pus cells without organisms. Marked stiffness and limitation of motion in joint when transferred to orthopedic service.

H. C. L.—Onset, April 19, with "aches in all bones." Entered hospital April 20, with profuse hemorrhagic eruption. Meningitis developed twenty-four hours later. Epididymitis was a complication. April 26 arthritis of left hip and knee, with local pain, redness and tenderness and moderate swelling. Serum intraspinally, 85 c.c.; intravenously, 445 c.c. Recovery.

A. O. K.—Admitted April 15, 1918, developed a petechial rash April 16. April 19 had severe pain in the left wrist with swelling, which subsided in forty-eight hours. Epididymitis was a complication. Serum: intraspinally, 110 c.c.; intravenously, 480 c.c. Recovery.

CONCERNING ASCENDING RENAL TUBERCULOSIS.¹

BY LEO BUERGER, M.D., F.A.C.S.,

NEW YORK.

THERE is almost a consensus of opinion today regarding the preponderance of the incidence of primary renal tuberculosis, with secondary descending infection of the ureter and bladder, authentic cases of primary involvement of the distal portions of the urinary tract being relatively rare. Some authors dispute the validity of the arguments of those who believe that ascending infection of the ureter and kidney can occur. It is our purpose in this paper to present some of our own clinical and pathological observations, as well as cystoscopic findings, that support strongly the contention of those who, admitting the rarity of the *ascending modus* of infection, still believe that it may obtain in a small percentage of the cases.

Experimentally a number of authors, among whom may be mentioned Albarran, Bernard and Wildboldz, have proved the possibility of producing a tuberculous infection of the kidney by way of the ureter. In order to bring about this result, however, a complex of conditions has to be complied with, such as can rarely be realized clinically. Bauereisen, basing his conclusions upon very thorough and experimental researches, contends that an ascending lymphogenic infection of the wall of the ureter is possible. However, the proofs submitted by authors of this school are not sufficiently convincing to be accepted.

In conflict with the views of the partisans of the "ascending modus" of infection may be cited anatomical findings in the kidney that refute seemingly strong evidences of primary bladder involvement. Thus profound vesical ulcerations and lesions, marked involvement of the lower ureter, with ulcerative and massive cheesy infiltration, associated with a dilated ureter above, but with very superficial changes—all these, although speaking in favor of a primary vesical tuberculosis, with ascending process, involving, first, the lower ureter, and then to a lesser degree the upper—can, in no sense, be accepted as proving the *ascending theory*, since it inevitably will be found that in practically all the cases described *old lesions of the corresponding kidney already exist*. It is therefore with considerable truth that Halle and Motz reply to the sponsors of the ascending theory. "We have still to find profound ureteral ostial lesions at the bladder, with complete integrity of the corresponding kidney."

¹ Read before the Genito-urinary Section, New York Academy of Medicine, May 21, 1919.

In short, whenever a kidney shows extensive or old lesions the mere finding of more extensive ulcerations in the inferior or distal ureter, or more extensive pathological destruction in the lower ureter than in the upper, cannot be regarded as offering testimony in favor of the ascending theory, since we know only too well that dependent portions, such as the lower ureter, may, by reason of the accumulation of tubercle bacilli and tuberculous products, and by virtue of the stagnation that can occur at this point, evidence alterations of greater extent than portions of the tract that have been involved for even greater periods of time.

There are, however, a number of reported cases in the literature that are in keeping with the cases that we shall report in this paper and that give more reliable and more conclusive evidence in favor of the validity of the ascending theory and which demonstrate that this modus of infection may obtain. Thus Wildbold reports the following case: The bladder, ureter and pelvis of the kidney tuberculous, *without any lesion in the parenchyma of the kidney*.

Hottinger cites the following case: Extensive involvement of the bladder and prostate; left ureter involved only at its inferior extremity, with the pelvis and the kidney itself healthy.

Although these cases definitely prove the possibility of the occurrence of ascending infection, the paucity of such observations testifies also to the rarity of this modus of infection.

As for the clinical observations that speak in favor of ascending infection, there are a number of types which could be mentioned. Probably most numerous are those cases in which the healthy sister organ becomes infected by the ascending route, the other kidney, ureter and bladder having been previously involved.

More rarely we may assume that reflux of urine into the ureter may obtain—this possibility being demonstrated clinically and pathologically—the involvement of the ureter then being secondary to a bladder infection, which in turn may supervene after a primary involvement of the prostate and testicles.

And then it is well known there are cases of congenital dilatation of the whole urinary apparatus in which cystoscopy demonstrates dilated and very much enlarged ureteral orifices and in which cystography, combined with ureterography and pyelography, have shown the existence of patency of the ureters and their wide communications with the bladder. In such cases not only are anatomical conditions given for the occurrence of ascending infection, but my own observations have proved to me that secondary ureteral and renal pelvic tuberculosis can occur.

Other clinical testimony in favor of the occurrence of the ascending infection is recorded by Rovsing, who described at the First International Congress of Urology six cases in which he had found dilatation of the ureter and pelvis of the kidney above a tuberculous stenosis of the lower end of the ureter, with progressive develop-

ment of lesions *from below upward*. In his cases the cause of the ureteral stricture varied, the primary focus being situated in the prostate, with secondary involvement of the bladder, and then the ureter.

According to some authors, among whom may be mentioned Rafin, the view is expressed that clinically tuberculosis of the bladder does not exist except in connection with renal tuberculosis. My own clinical observations, however, have demonstrated to me that we must accept the possibility of the incidence of primary tuberculosis of the bladder, although the integrity of both kidneys is difficult to prove in those cases in which exploratory operation has not been performed, and although the number of cases in which nephrectomy was done and in which the ascending *modus* seems to be definitely shown is a small one.

In short, from the literature one would say that the results of animal experimentation, studies of pathological specimens and investigations along clinical lines offer indisputable evidence that the ascending *modus* of infection may obtain, although when the cases are carefully analyzed and compared with the numbers belonging to the descending class their paucity and rarity is astonishing, to say the least.

It may be well, therefore, to add several cases from my own case records, which cast some doubt on the general dictum, so widely accepted today, that a tuberculous bladder means a primary tuberculous kidney—cases that present, furthermore, points of diagnostic interest as well as valuable hints as to prognosis.

Certain cases have come under my observation that offer clinical and pathological evidence in favor of the assumption that *ascending infection* of the urinary tract with tubercle bacilli does occur.

The observations to be cited may be of some clinical as well as pathological interest, for they concern patients that evince the seemingly paradoxical phenomenon of a clinical cure or at least marked improvement of what *appears to be* the *primary* tuberculous focus when the secondary focus is removed. By this we mean that in two of our cases that presented marked bladder symptoms, with superficial tuberculous ulcerations, marked ureteral tuberculosis and infection of one kidney, either the pelvis alone being involved or associated with a minute parenchymal focus—most remarkable amelioration of the vesical lesions occurred after nephrectomy. So that after the removal of what appeared to be the secondarily involved renal focus the bladder symptoms disappeared completely, and even tubercle bacilli, whose presence had been demonstrated on several occasions before operation, could not be found several months after nephrectomy had been done.

This would appear to cast some doubt on the validity of the assumption that the bladder or some distant urinary part was primarily involved, but the pathological findings, as well as some of

the clinical observations, speak against this view, as will be seen by a close study of the history and the results of examination.

We must then assume that in our cases of ascending urinary tuberculosis the bladder could not take care of itself by reason of the fact that the ureter had been extensively involved and that possibly a small focus, secondarily produced in the kidney, was sufficiently large to form a storehouse for the accumulation and further propagation and distribution of the tubercle bacilli.

Let us briefly summarize some of the views regarding the inception of a tuberculous process in the urinary tract, alluding first to what is known as "the theory of primary invasion of the cortex of the kidney."

According to the views of some authors, among whom can be mentioned Koenig and Pels-Leusden, chronic tuberculosis of the kidney begins, in the majority of cases, with the formation of small cortical miliary tubercles that multiply, extend into the medulla and finally perforate into the pelvis of the kidney. The solitary or multiple tubercles that appear in the renal cortex early in the development of renal tuberculosis have no relation to the renal calyces or pelvis. Such foci may remain in the kidney for years without causing the appearance of tubercle bacilli in the urine.

More recent observations and studies, however, have demonstrated *this latter view to be incorrect*. In fact it has been shown that such tubercles are merely acute or subacute miliary tubercles of the kidney, that may arise shortly before death and whose further development is arrested by the death of the patient. In fact, most of the recent observations have definitely proved that chronic renal tuberculosis has its inception *most frequently* in the medulla, in some cases in the boundary zone between cortex and medulla and in other cases in the renal papillæ. Those foci which develop in the medulla seem to emanate from lesions of one papilla or in the transitional region between the calyx and papilla, often in the recesses of the calyx.

According to Wildboldz the following may be regarded as the first stages in the development of tuberculosis of the kidney.

In a kidney that is externally practically normal, with or without a small group of tubercles in the cortical zone corresponding to the site of the lesions, we see on cross-section of the organ a practically normal surface except for the changes in one or more papillæ. Thus in one or more papillæ, possibly some distance from each other, there develop smaller or larger yellowish nodules, with coagulation necrosis or breaking down in the direction of the renal pelvis, with the formation of an ulcer. Sometimes it is only the tip of a papilla that is involved, while at other times there may be merely a suggestion of a lesion at the tip of the papilla in the form of swelling, unusual pallor of the papilla, with a peculiar glossy alteration of the tissues. In other cases there may be found in a niche or recess of

the minor calyces an ulcer that lies partly in the calyx wall and partly over the margin or surface of the papilla. In later development we may find minute miliary tubercles arranged in a radiate manner in the pyramids corresponding to the involved papillæ.

On microscopic section we find miliary tubercles, with miliary or conglomerate agminated tubercles and some coagulation necrosis surrounded by a reactionary zone of lymphocytes, that usually extends toward the pelvis, where necrosis of the epithelium has taken place, with the formation of a cheesy ulcer.

It is from these small beginnings, the primary foci in the kidney itself, that we get all those vast destructive lesions in the kidney that are known so well—namely, the formation of tuberculous cavities; the conversion of the kidney into a tuberculous pyonephrosis; the secondary involvement of the renal pelvis, with miliary tubercles, conglomerate tubercles, cheesy deposits, indurated lesions, stenotic lesions, with retention of urine and inflammatory products in the pelvis of the kidney; the changes in the ureter; the secondary involvement of the bladder and of the distal urinary and sexual organs.

With these generally accepted views as to pathology in mind, the arguments in favor of the ascending theory offered by our cases may be better appreciated.

The following cases from my files are interesting examples of ascending renal tuberculous infection.

CASE I.—*Tuberculosis of the bladder; tuberculosis of the right ureter; minimal changes in the right kidney; tubercle bacilli obtained from the bladder and right kidney; vesical symptoms and tubercle bacilli disappear from the urine after nephrectomy.*

F. S., female, aged fifty-seven years, mother of eight children, consulted me on April 29, 1918, with the complaint that micturition was painful and very frequent, there being almost a constant desire to void.

These symptoms, the urgency, the pain on urination and the voiding in small quantities frequently, had been present for about four months. For the last four days blood had been present in the urine. There had been no noticeable loss in weight and no symptoms referable to the kidney other than an occasional ache in both lumbar regions, not partaking of the nature of renal colic and ill-defined in localization. Lately she has been voiding twice at night, and when in the direct posture she has almost a constant desire to void.

Cystoscopy (April 29, 1918). Examination of the bladder shows an irregularly shaped ulcer over the anterior wall not far from the sphincter, surrounded by inflamed mucous membrane. In this neighborhood there are a few follicles, suggestive rather of follicular cystitis than tuberculosis. Throughout the bladder there are

patches suggestive of cystitis en plaque, neither orifice showing anything suspicious of tuberculosis.

Both ureters were catheterized, the urine being almost clear from both sides, the right containing red blood cells but no pus.

Examination of the separated urinary specimens of the right and left kidney and bladder for tubercle bacilli showed the presence of tubercle bacilli in the bladder, and none in either the right ureter, right kidney or left kidney specimen.

In short, in this case the first cystoscopy suggested an ulcerative cystitis, with lesions very near the sphincter, over the roof of the bladder and anterior wall, because of the presence of an irregularly shaped superficial ulcer, together with the patchy cystitis.

Therefore, symptoms suggestive of a possible tuberculous ulcerative condition, with nothing strongly suspicious of primary involvement of either kidney, but with the finding of tubercle bacilli in the bladder specimen.

Cystoscopy (May 2, 1918). At this second examination both ureters were again catheterized, the specimens from the right side containing some blood, the specimen from the left kidney being negative. *Tubercle bacilli were present in the right kidney and bladder specimens.* The right ureteral orifice was seen to be somewhat irregular in shape, somewhat crenated, pus being absent in the renal specimens, although tubercle bacilli were found in the right kidney specimen.

In view of the absence of pus in the right kidney specimen, the negative left kidney specimen, the discrepancy between the meager findings in the right kidney, the extensive lesions in the bladder and the finding of tubercle bacilli, it was deemed advisable to do a third cystoscopy in order to obtain further light as to whether the right kidney was involved or not. It may be said that in order to prevent regurgitation of fluid from the bladder into either kidney specimen obtained through the ureteral catheter, it is always my practice to empty the bladder first thoroughly through the cystoscope while specimens are being collected from the kidney. Reflux or regurgitation backward into the ureters, therefore, could be ruled out as a factor in determining the presence of tubercle bacilli in either kidney specimen.

Cystoscopy (May 6, 1918). A third examination, therefore, was deemed advisable, since the role played by the right kidney in the pathological process at hand was not clear. It was decided therefore to collect at least four separate specimens from the right kidney during five-minute periods each, with the catheter in the pelvis of the kidney, in order to be absolutely certain as to the involvement of the right renal organ.

The report on the separated urinary specimens thus collected showed the *absence of tubercle bacilli* in all the left specimens, the presence of tubercle bacilli in the bladder and the presence of

tubercle bacilli in the second, third and fourth right kidney specimens, approximately collected during the second, third and fourth period of five minutes each, the first specimen having been discarded, inasmuch as contamination, due to the passage of the ureteral catheters through the bladder, must be ruled out in all such examinations.

In short, in a case giving the typical bladder symptoms of renal and vesical tuberculosis, with superficial ulcerations in the bladder, with tubercle bacilli in the bladder urine, with an apparently normal left kidney, and with tubercle bacilli in the right kidney specimens on three different occasions, we were confronted with tuberculous lesions of the bladder, probably also of the right ureter and right kidney. Cystoscopic findings spoke strongly against any marked involvement of the integrity of the right kidney, inasmuch as its functional activity was good and pus cells could not be obtained at any time from the pelvis of the right kidney itself.

Inasmuch as bladder irrigations that had already been tried before the patient had consulted me, and were again carried out under my supervision for a period of some two weeks, did not seem to ameliorate the condition, it was decided to do an exploratory operation upon the right kidney, in the hope that a primary focus could be found in this organ, although the urinary evidences were doubtful.

May 15, the right renal nephrectomy was easily carried out and a small organ, showing on its external surface no evidences of tuberculosis, was removed, in view of the fact that the ureter was thickened, particularly in its lower portion, the changes in it being sufficient to warrant the assumption that it was involved in a tuberculous process. Whether in the ascending or descending sense could not be determined.

The specimen when bisected seemed at first sight to be that of a perfectly healthy organ, but on closer inspection it was seen that there were at least three tuberculous foci of very small extent in the parenchyma. One of these, evidently a focus that in no way communicated with the pelvis, was about 3 to 4 mm. in diameter and suggested strongly confluent miliary tubercles and two additional smaller miliary tubercles were found in the cortex in a situation corresponding to that of the larger lesion. There were no ulcerations at the tips of the papillæ, but one suspicious minute tuberculous focus in one of the recesses of a calyx, which on microscopic examination was found to be a miliary tubercle of considerable size that had not as yet undergone cheesy degeneration and involved a calyx in one of its recesses, the section being very difficult to find, necessitating a large number of microscopic sections.

In short, there was no lesion macroscopically indicative of primary involvement of the kidney, but miliary tubercles without cheesy degeneration and not communicating directly with the pelvis.

The small size of the lesion, the absence of necrosis and absence of direct pelvic communication rule this out as being responsible for the lesions lower down in the urinary tract and for the presence of tubercle bacilli in the urine.

The pelvis showed a few scattered tubercles, while the ureter showed many more tubercles than the pelvis, their numbers becoming greater as the lower portion of the ureter was examined.

In brief, minimal secondary lesions in the kidney, few miliary tubercles in the pelvis, numerous tubercles in the ureter, with some areas of superficial ulceration and extensive lesions in the bladder.

These findings, it appears to me, are sufficiently characteristic to warrant the assumption that we were dealing here with a tuberculous process that had secondarily involved the kidney and the ureter, the most marked lesions being present in the bladder.

SUBSEQUENT CLINICAL COURSE. The patient made an uneventful recovery after nephrectomy, but the bladder symptoms persisted for some time. No treatment was prescribed for the bladder, as it was doubtful as to whether complete restitution to normal could take place, in view of the fact that the lesions of the kidney could hardly be held responsible for the lesions in the bladder.

During the summer of 1918 gradual improvement occurred, although a moderate amount of pollakiuria was still noted in September.

In October, 1918, she felt considerably improved and a cystoscopic examination was made on October 22. The ulcers had completely disappeared, the bladder showing marked improvement. The only lesions that could be detected were a moderate degree of redness, patches over the anterior wall near the sphincter, some follicular cystitis, the ureteral orifices being normal. *In short, disappearance of the ulcers and marked improvement.* October 23, *examination of the bladder urine failed to show the presence of tubercle bacilli.* Since then tubercle bacilli have been absent, and the patient in April, 1919, reports that she is practically well. Cystoscopy May 8, 1919, showed a bladder that could be regarded as almost normal.

Epicrisis. Enough data have been adduced in this case to strongly support the view that the involvement of the kidney was secondary to a process lower down in the urinary tract. Whether the renal lesions are secondary embolic invasions through the blood stream or in the true ascending sense cannot be determined. Certain it is, however, that they are of more recent date than the bladder lesions. What, however, is not so clear is how the nephrectomy could possibly have influenced the vesical process so rapidly, not only in contributing to the disappearance of the ulcers, but also in causing the absence of tubercle bacilli in the urine. Perhaps the following is the explanation. That by reason of the tuberculous

involvement of the distal part of the ureter and the marked relaxation and insufficiency of the vesical orifice a certain amount of reflux regularly occurs—that stagnation in the ureter follows—so that tubercle bacilli are present in the pelvis rather by virtue of reflux than either by secretion through the kidney or by reason of the breaking down of the tuberculous focus in the kidney itself. This would explain the finding of tubercle bacilli in all the specimens obtained from the kidney even though collected over a long period of time (twenty-five minutes), the lesions of the parenchyma of the kidney being too minute to warrant the belief that tubercularia could possibly be due to their presence. With the removal of the kidney and a large portion of the ureter a closed focus or pouch in which tubercle bacilli could be secreted and retained was eliminated and the bladder then was able to take care of itself. It is only in this way that we can explain the paradoxical result that followed the removal of a kidney with such insignificant minute minimal lesions.

The second case to be cited was even more striking in its offering of pathological evidence, that ascending tuberculosis of the urinary tract occurred. A kidney obtained at nephrectomy was slightly hydronephrotic, the pelvis showing extensive miliary tuberculosis, the parenchyma of the kidney being free except for a very few scattered miliary tubercles, these being visible after the capsule of the organ was stripped.

CASE II.—Extensive ulcerative tuberculosis of the bladder; left-sided pyuria; tubercle bacilli in the specimens from the left kidney and also in the bladder, in a patient suffering from marked frequency of urination, dysuria, with occasional attacks of pain in the left hypochondriac region, nephrectomy showing a somewhat hydronephrotic kidney with tuberculosis of the pelvis, the parenchyma being free except for a few miliary tubercles.

A. E., female, aged sixty-seven years, consulted me on July 12, 1918, having been referred by Dr. P. Friedman, with the following history:

There had been attacks of pain in the left hypochondrium for about one year, the pain radiating to the left lumbar region and downward into the bladder; increasing urinary frequency, so that she frequently had incontinence during the day, voiding four to five times at night. Lately clots of blood had appeared in the urine.

Cystoscopy (July 12, 1918). Extensive ulcerations were found, and polypoid edema about the left ureteral orifice. The specimens from the right kidney were clear. Indigocarmin appeared in moderate concentration in the right kidney specimens. The left kidney specimens were cloudy, with a practically negative output of indigocarmin.

On microscopic examination numerous pus cells were found in the left kidney specimens, the right specimens being clear, tubercle bacilli being found in the left kidney specimen and bladder.

Tentative Diagnosis. Tuberculosis of the left kidney and bladder. The patient refused operative intervention until September, 1918, when, in view of the persistence of symptoms, acquiescence was obtained.

Nephrectomy (September 20, 1918). Through the usual oblique incision (Albarran) a somewhat enlarged kidney was liberated from adhesions, the external surface evidencing no sign of tuberculous lesions. The pelvis, however, was markedly dilated (hydronephrotic), considerably thickened and evidently tuberculous. The ureter was also found very much thickened; in its lower portion, sclerotic and indurated; in its upper, dilated.



FIG. 1.—Renal pelvic tuberculosis showing an unusual type of ascending tuberculosis in which the pelvis was diffusely involved with miliary tubercles, the kidney being practically negative, except for a few small miliary tubercles seen in the upper pole and in the tissue of the mid-portion of the kidney.

The Pathological Specimen. On careful examination the kidney itself was found somewhat hydronephrotic, the extrarenal pelvis being particularly dilated. Careful examination of all the papillæ and the cortex revealed absolutely no evidences of tuberculosis. On stripping the capsule, however, a number of miliary tubercles, possibly seven or eight in all, were discovered, one of these showing tuberculosis on microscopic section.

The interior of the pelvis was diffusely tuberculous, in places

showing discrete tubercles, but for the most part covered by myriads of tubercles fusing with each other (Fig. 1) and becoming more and more marked in the distal direction, the upper ureter region being extensively diseased, the ureter itself markedly thickened. The lower portion of the ureter showed marked indurative tuberculosis, with superficial tuberculous ulcerations.

In short, we have here a case in which the tuberculous lesions of the bladder were very marked, ulcers and polypoid edema being present, in which the ureter gave evidences of an extensive old tuberculous process, with some narrowing at its lower end, with consequent dilatation of the extrarenal pelvis, the latter showing extensive miliary tuberculosis. *The absence of tuberculous lesions in any of the papillæ, in the calyces and in the peripheral portions of the pelvis, the freedom of the renal parenchyma (except for a few miliary tubercles) seem to present sufficient evidence in favor of the assumption that here we were dealing with an ascending tuberculous process.*

The patient made an uneventful recovery after nephrectomy.

Future Course. The bladder symptoms rapidly disappeared, so that on May, 1919, the patient reported herself practically well.

While these two cases illustrate what we may regard as indisputable instances of ascending tuberculous infection, *there are certain other unusual cases of renal tuberculosis, that might be incorrectly assumed to belong to this class.* These are the cases in which the focus in the kidney is relatively minute, takes the form of a small ulcer of the pelvis, or of a calyx, or is represented by a cheesy plaque in one of the terminal recesses of a calyx wall. Be these lesions ever so small, however, they must be regarded as indicative of primary involvement of the kidney, for they never fail to show evidences of being of considerable age, are always disintegrated, cheesy foci from which the propagation of the tuberculous process downward takes place.

Thus in the following case to be cited, Fig. 2 shows an old and cheesy lesion of the mucosa of a calyx, while Fig. 3 is an example of a still older zone of coagulation necrosis of mucous membrane of a calyx in another case reported elsewhere by me.²

CASE III.—*Descending tuberculosis of the kidney simulating ascending tuberculosis; minimal renal lesions; practically intact renal parenchyma; minute lesions in calyces; diseased pelvis; extensive tuberculous ureteritis and cystitis.*

N. S., aged thirty-eight years, male, was admitted to the surgical service of the Mount Sinai Hospital, under my care, in July, 1917, with the usual symptoms characteristic of tuberculosis of the kidney and bladder—namely, frequency of urination, burning on urination, nocturia lasting for about six months and the passage of cloudy, purulent urine containing tubercle bacilli. On cystoscopic exami-

² New York Med. Jour., January 5, 1918.

nation, July 26, 1917, I found the usual lesions of tuberculosis in the bladder, polypoid edema about the right ureter and slight retraction in this region. Both kidneys functioned well, as evi-

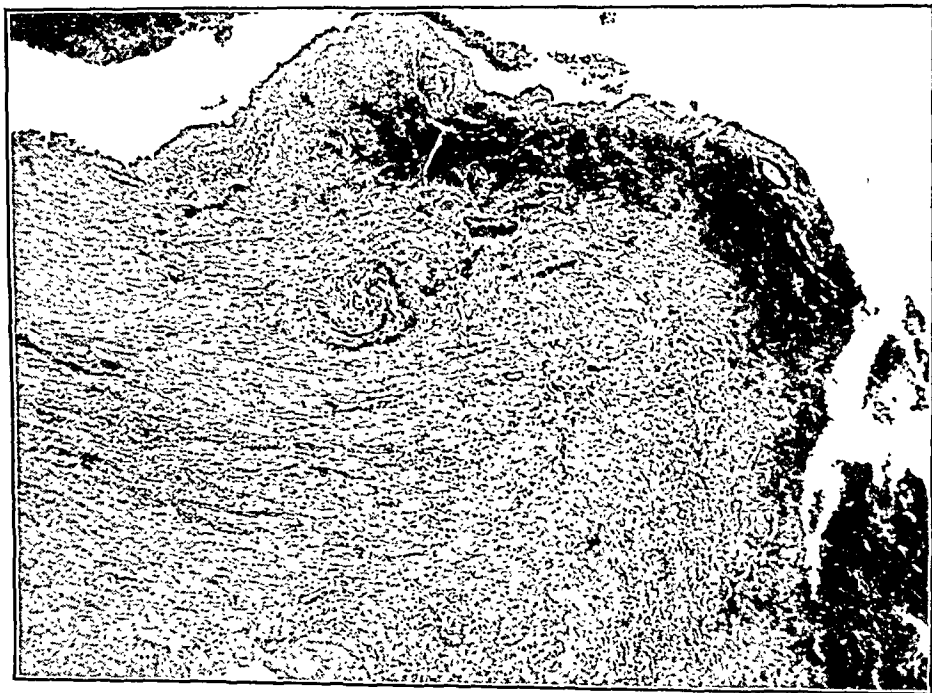


FIG. 2.—Necrosis of mucosa of a calyx, the only tuberculous lesion found.



FIG. 3.—Coagulation necrosis of mucous membrane of a calyx (on the right).

denced by the output of indigocarmin, and a small number of white blood cells were found in the specimens obtained from both kidneys; but tubercle bacilli were found only in the specimens from the right kidney. A diagnosis of right renal and vesical tuberculosis was made.

On August 4, 1917, I did a typical nephrectomy, the following interesting lesions being encountered: The kidney was but slightly

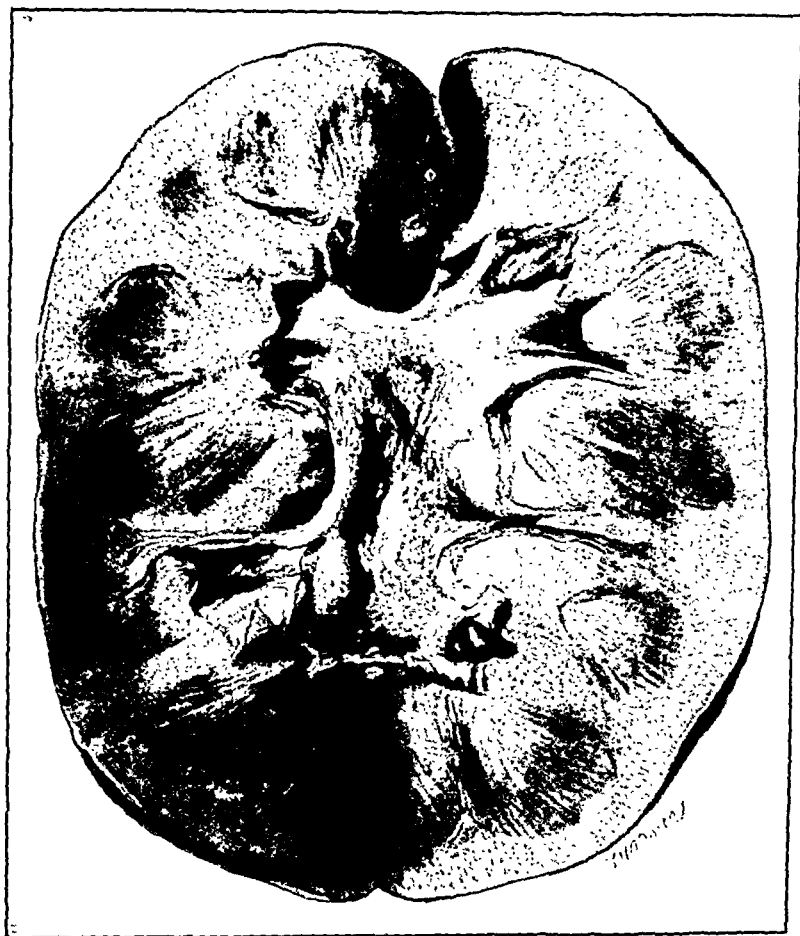


FIG. 4.—Apparently intact kidney, with no gross surface lesions suggestive of tuberculosis, harboring small lesions in the calyces, and showing a thickened granular pelvis.

adherent, fairly movable, about normal in size, with no gross evidence of tuberculous involvement. The ureter was therefore palpated and was found densely adherent to the posterior parietes and surrounded by a mass of connective tissue, so firm in consistency that it appeared to be almost impossible of removal. With some difficulty a ureter as thick as a man's little finger was freed for a distance of about six inches, ligated and cut through, and the kidney was then removed.

It is the picture (Fig. 4) of this specimen of kidney pelvis and ureter with its seemingly normal parenchyma and its apparently extensive involvement of the pelvis of the kidney and ureter, that is worthy of consideration. This demonstrates the difficulty of macroscopic recognition of the lesions of renal tuberculosis.

On bisection of the kidney the only striking lesion that could be viewed with the naked eye was an intense inflammatory process involving the pelvis of the kidney and calyces, by virtue of which the pelvis was thickened to about three times the normal, its surface granular as if covered by a multitude of miliary tubercles, moderately reddened, but nowhere showing the lesions of tuberculosis, the small granules appearing much larger than those characteristic of miliary tuberculosis. No miliary tubercles could be seen in the parenchyma, nor were there any gross ulcerations of the apices of the papillæ. In short, macroscopically we had an apparently normal kidney with a very much thickened, inflamed and indurated pelvis and an enormously thickened ureter which, in a limited number of sections, showed nothing absolutely characteristic of tuberculosis.

It was not until a number of sections had been made through some of the hidden portions of the calyces, which had not appeared on bisection of the organ, that typical cheesy ulcerative lesions of tuberculosis were found. These involved a calyx without, however, showing any true miliary tubercles (Fig. 2).

These cheesy lesions should be regarded as absolutely characteristic of tuberculosis, when they are present in the kidney calyces, pelvis or ureter, and the diagnosis may be made even without the finding of endothelioid and giant cells. The photomicrograph represented in Fig. 2 shows a section through such a necrotic calyx. Above the mucous membrane is seen to be replaced by a zone of coagulation necrosis. The submucous connective tissue is markedly thickened by virtue of connective-tissue proliferation, and there are the cellular evidences of a chronic productive inflammatory process.

In a case of frank vesical tuberculosis, with tubercle bacilli in the urine and with typical lesions about the right ureteral orifice, we removed an enormously thickened ureter, doubtlessly tuberculous, and a kidney with minimal changes, changes insufficient for recognition by the surgeon at the operating table and requiring thorough investigation on the part of the pathologist for their detection.

Despite the preponderance of the infrarenal (ureterovesical) lesions here, we can safely adjudge the tuberculous process to have been developed in the descending sense.

If we compare the renal lesions in our cases of ascending tuberculosis with those mentioned as possibly giving rise to confusion in interpretation (as Case III), we will see, on the one hand, that in Cases I and II there was a tuberculous pyelitis associated with

discrete and in one instance confluent miliary nodules in the parenchyma, lesions that can be correctly estimated as of recent development, while, on the other hand, the lesions present in Case III (Figs. 2 and 3) are evidently very old, as evidenced by the extensive coagulation necrosis and the reactive fibrotic condition in the immediate neighborhood.

SUMMARY. We have given clinical and pathological proof of the occurrence of cases of ascending renal tuberculosis, ascending at least in the sense that the renal and ureteral lesions are secondary to the bladder involvement; we have shown that minimal tuberculous renal lesions, when associated with extensive vesical and ureteral changes, are doubtless, in some cases, later involvements of the urinary tract, be they produced in the true ascending, canalicular sense of propagation by contiguity or in a more circuitous fashion by late embolic invasion of the kidney; and, by the results of the removal of the kidney in two of the cases, have given ample testimony of the value of nephrectomy even in this type of urinary tuberculosis. Although the renal parenchyma is practically uninvolved in some of these cases the retention of tuberculous urine in the pelvis of the kidney and the constant contamination of the bladder with tuberculous products elaborated in the ureter are sufficiently active factors in interfering with recovery.

EFFECTS OF THE INJECTION OF ATROPIN ON THE PULSE-RATE, BLOOD-PRESSURE AND BASAL METABOLISM IN CASES OF "EFFORT SYNDROME."

BY CYRUS C. STURGIS, FIRST LIEUT., M.C., U.S.A.,
PENDLETON, OREGON,

JOSEPH T. WEARN, M.D., FIRST LIEUT., M.C., U.S.A.,
CHARLOTTE, N. C.,

AND

EDNA H. TOMPKINS,
CAMBRIDGE, MASS.

(From the Cardiovascular Division of the Medical Service, U. S. Army General Hospital No. 9, Lakewood, New Jersey.)

INTRODUCTION. During the studies upon the "Irritable Heart of Soldiers" at U. S. Army General Hospital No. 9, it was found that a considerable percentage of the cases were responding in a characteristic way to standard injections of epinephrin,¹ while others of the group reacted no more to the drug than did a normal individual. In patients sensitive to the drug there was in each

¹ Wearn, J. T., and Sturgis, C. C.: Effects of the Injection of Epinephrin in Soldiers with "Irritable Heart." (To be published.)

instance a rather marked increase in the pulse-rate. This effect on the heart-rate is probably due to the action of epinephrin on the accelerator fibers to the heart. In view of this fact, it was decided to study further the nervous control of the heart in soldiers with "effort syndrome," by observing the action of atropin sulphate on the vagus control.

The patients studied gave a history of the symptoms and signs of "effort syndrome" or "irritable heart," dating back in some of them to childhood, and in all of them a number of years. Some of them were epinephrin sensitive and others were not.

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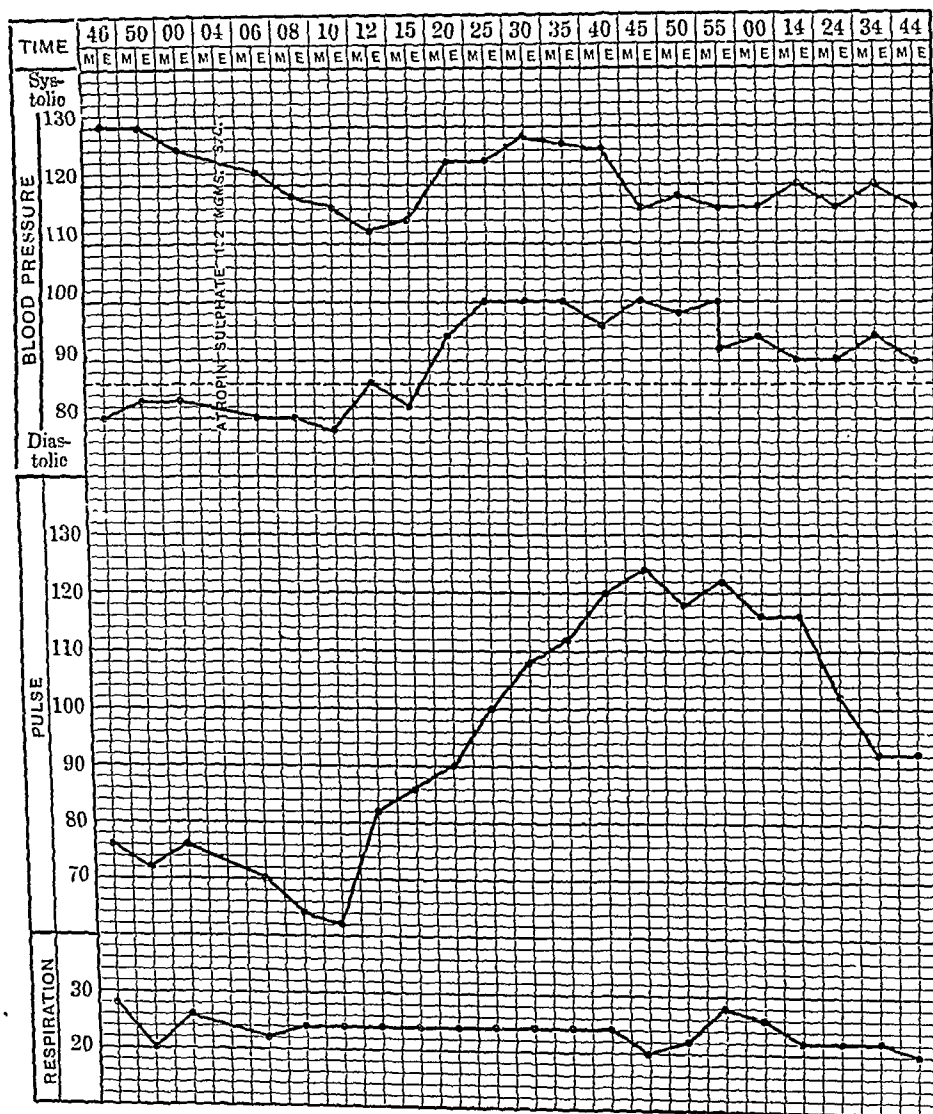


Chart showing the method of recording results after subcutaneous injection of atropin.

METHOD. The patient was rested in bed for one hour or longer until the pulse-rate and blood-pressure readings were constant.

Atropin sulphate, 1.2 mg., was then injected subcutaneously into the upper arm, and observations of the pulse-rate, blood-pressure and objective and subjective symptoms and signs were made every three minutes for nine minutes, then every five minutes for an hour or more if the effects of the drug were still present. The accompanying chart and Table I are illustrative of the method of recording results. In cases in which a simultaneous study of the gaseous metabolism was to be made the patients were fasted for twelve hours or more. Otherwise, they may or may not have fasted.

TABLE I.

Time.	Tremor.	Sweat.	Flush.	Pulsations.	Hands.	Miscellaneous.
8.46	+	Slight on palms	0	+	Warm	Quiet.
8.50	+	"	0	+	"	"
9.00	+	"	0	±	"	"
9.04		Atropin	sulphate, 1.2 mgm. s. c.			
9.06	+	Slight on palms	0	±	"	"
9.08	+	"	"	"	"	"
9.10	+	"	"	"	"	"
9.20	+	"	"	"	"	"
9.25	+	"	"	"	"	"
9.30	+	Very slight	"	"	"	"
9.35	+	0	"	"	"	"
9.40	+	0	"	"	"	"
9.45	+	0	"	"	"	"
9.50	+	0	"	"	"	"
9.55	+	0	"	"	"	"
10.00	+	0	"	"	"	"
10.14	+	0	"	"	"	"
10.24	+	0	"	"	"	"
10.44	+	0	"	"	"	"

METABOLISM. The metabolism was determined by the Tissot method. The patient's expired air was collected in the spirometer by means of a half-mask and Tissot valves. It was analyzed with the portable Haldane gas-analysis apparatus. All volumes were collected and computed in the standard way. The nitrogen metabolism was not determined. Each period of a determination was of ten minutes' duration, and, unless it started within ten minutes of an injection, was made with a new placement of the mask. All patients were fasting twelve or more hours.

In cases in which patients were unfamiliar with the apparatus, two basal periods were carried out; but since most of the cases had had satisfactory determinations previously, but one basal period was run ordinarily.

RESULTS. We have injected 1.2 mg. atropin sulphate into 10 normal men and into 21 soldiers with "irritable heart," and noted the following effects: In the normal men, following the injection of the drug, there was an immediate drop in pulse-rate

in 9 of the 10 subjects. This drop was followed immediately by a rise in the pulse-rate varying from six to thirty beats per minute.

In 9 of the 10 normal subjects there was an increase in the diastolic blood-pressure, and 8 showed a drop in systolic blood-pressure. All of the normal men showed a drop in pulse-pressure. This drop in pulse-pressure occurred before the maximum increase in pulse-rate in 6; in 2 others it followed the maximum rise, and in the remaining 2 it occurred simultaneously with the maximum increase in pulse-rate.

TABLE II.—SHOWING PULSE-RATE CHANGES AND THEIR RELATIONS TO INJECTIONS OF ATROPIN SULPHATE IN SOLDIERS WITH “IRRITABLE HEART” OR “EFFORT SYNDROME” AND IN NORMAL MEN.

	Number of subjects.	Number showing drop in pulse-rate.	Average maximum drop in pulse-rate.	Number showing increase in pulse-rate following the drop.	Average time of beginning increase in pulse-rate after injection.	Average maximum pulse-rate increase.	Average time of maximum pulse-rate increase after the injection.
Cases of Effort syndrome	21	19	10 beats per min.	20	8 min.	30.4 beats per min.	37.4 min.
Normal men	10	9	10.2 beats per min.	9	10.5 min.	21.8 beats per min.	39 min.

TABLE III.—SHOWING CHANGES IN BLOOD-PRESSURE FOLLOWING INJECTION OF ATROPIN SULPHATE INTO SOLDIERS WITH “IRRITABLE HEART” OR “EFFORT SYNDROME” AND INTO NORMAL MEN.

	Number of subjects.	Number showing a rise in diastolic blood-pressure.	Average rise in diastolic blood-pressure.	Number showing drop in systolic blood-pressure.	Number showing rise in systolic pressure.	Number showing drop in pulse-pressure.	Average drop in pulse-pressure.
Cases of Effort syndrome	21	20	11.9 mm. mercury	11	10	14	14.5 mm. mercury
Normal men	10	9	7.8 mm. mercury	8	0 ²	10	10.8 mm. mercury

There was little difference in the response of the “effort syndrome” cases to the drug. As is shown in Tables II and III the most noticeable differences are the greater increase in pulse-rate

² Two showed no change in systolic blood-pressure.

in the cases with "effort syndrome," and the fact that on the average the increase in rate began sooner than it did in the normal controls.

The changes in blood-pressure were about the same in both groups. One rather striking change which was common to both groups was the fact that the compensatory drop in pulse-pressure was caused more by a rise in the diastolic than by a fall in the systolic blood-pressure. This rise in diastolic pressure varied from 4 to 25 mm. of mercury.

In the "irritable heart" cases and in the normal controls, dilatation of the pupils was noted, and dryness of the mouth was frequently complained of.

METABOLISM RESULTS. Higgins and Means³ reviewed the literature upon the respiratory exchange under atropin and added the reports of studies upon themselves as normal subjects. They concluded there was a slight elevation in metabolism and an increased dead space due to dilatation of the bronchi after therapeutic doses of atropin.

The metabolism was studied by us in 6 cases under the effects of atropin. The time interval between the injection and the metabolism determination depended upon the pulse curve after the administration of the drug. In 4 of the cases a period was taken shortly after the injection, at the time of the pulse depression which ordinarily precedes the later rise. Two of these showed a small drop in the heat production and two showed rises so slight as to be within the upper limit of error. They gave no noteworthy change in respiratory rate, volume or quotient.

In each case one period was run as nearly as possible at the time of the greatest pulse acceleration. Under that condition three of the patients showed a small drop in the metabolism and three no change worthy of mention. This is interesting in view of the often discussed problem of how great a part increased heart activity plays in the elevation of metabolism under various conditions, and may be of some value as partial evidence that the increase in metabolism that occurs after epinephrin injection is not due to acceleration of the pulse. The respiratory quotient dropped slightly in each case. The respiratory rate and volume did not vary beyond a normal basal limit. Table IV summarizes these results.

SUMMARY. In cases of "irritable heart" and in normal men after injection of atropin sulphate there was generally a preliminary drop followed by an increase in pulse-rate. This increase was greater on the average in the "irritable heart" cases than in the normal controls. There was also a drop in pulse-pressure in the majority of the subjects, dependent upon a rise in diastolic blood-

³ Jour. Pharmacol. and Exper. Therap., 1915, vii, 1.

TABLE IV.

Case No.	Name.	Age.	Height.	Weight.	Period No.	Minutes from injection to period start.	CO ₂ per min.	O ₂ per min.	R. Q.	Pulse.	Resp.	Vol. per min. S.T.P.D.	Vol. per resp.	Cal. per sq. meter per hour.	Metabolism, per cent. from normal.	Amount of metabolic change.
1	G. A.	24	Cm. 174	Kg. 68.4	1-2		C.c. 212	C.c. 251	0.85	75	14.6	5.76	C.c. 396	39.9	+ 1	5
					3	5	198	241	0.82	59	14.3	5.29	371	38.1	- 1	2
					4	37	203	246	0.83	99	14.0	5.51	394	39.0	-	
2	D. C.	26	177	64.1	1	3	211	260	0.81	59	13.3	5.45	411	41.7	+ 6	3
					2	45	211	269	0.78	59	15.5	5.54	358	42.9	+ 9	4
					3		214	273	0.78	92	15.7	5.61	357	43.4	+ 10	
3	R. D.	23	173	51.6	1	17	185	209	0.89	70	12.4	4.92	398	38.2	+ 3	1
					2		176	210	0.84	102	12.3	4.74	387	38.0	+ 4	
4	E. G.	24	165	58.9	1-2		194	238	0.82	70	11.4	5.57	491	41.7	+ 6	4
					3	3	201	247	0.81	64	11.2	5.67	508	43.3	+ 10	8
					4	28	171	225	0.76	91	11.5	5.02	436	38.8	- 2	
5	M. L.	19	167	62.0	1	46	195	229	0.85	76	16.1	5.72	355	38.8	- 2	6
					2		170	217	0.78	97	13.8	5.02	363	36.2	- 8	
6	H. R.	24	169	60.2	1-2		201	264	0.77	69	31.2	7.31	236	44.8	+ 13	6
					3	3	190	248	0.77	64	40.8	8.57	210	42.2	+ 7	
					4	42	189	251	0.75	103	31.5	7.97	253	42.4	+ 7	

pressure in the majority of cases and upon an additional drop in systolic blood-pressure in some of the cases.

There was no increase in basal metabolism after the subcutaneous injection of atropin sulphate.

There was a slight fall in the basal metabolism in three of the six cases studied.

There was always a slight drop in the respiratory quotient.

POINTS OF DIFFERENTIAL DIAGNOSTIC VALUE IN PULMONARY ABSCESS, BRONCHIECTASIS AND PULMONARY TUBERCULOSIS, WITH AN EXPLANATION OF THE CAUSE OF THE DIFFERENCE IN AUSCULTATORY FINDINGS.¹

By FRANCIS MARION POTTENGER, A.M., M.D., LL.D.,
MONROVIA, CALIFORNIA.

PULMONARY abscess, bronchiectasis and pulmonary tuberculosis are very often wrongly diagnosed. Unless one has had considerable opportunity to examine patients suffering from each of these diseases, he is liable to experience considerable difficulty in differentiating them. If, however, a careful study of the disease and the manner in which it affects the patients is made the differentiation will not be so difficult. Both pulmonary abscess and bronchiectasis are often diagnosed as tuberculosis on the basis of cough and expectoration. The fact that bacilli are not found is no longer sufficient to prove the non-tuberculous nature of a pulmonary process; consequently, this fact confuses more than it helps. In my own work I have had opportunity to study numbers of patients who were expectorating large quantities of sputum. Some of these have been of a tuberculous nature, yet bacilli have been found only at rare intervals. In other patients who had had a definite tuberculous process which had been accompanied by cavity formation and sputum containing bacilli the general process healed, leaving a secreting cavity, with a considerable amount of expectoration in which tubercle bacilli were not found, even after repeated examination. So while the presence of tubercle bacilli shows the definite tubercular nature of sputum, their absence does not prove the process to be non-tuberculous.

CLINICAL HISTORY. Pulmonary abscess usually follows acute infection of the lung, in which such organisms as streptococci, staphylococci or the pneumococci are the etiological factors, such as have been common during the epidemics in both army and civil life during the past two years. It also follows operations on the

¹ Read before the Annual Meeting of the American Climatological and Clinical Association, at Atlantic City, June 14, 16 and 17, 1919.

teeth, tonsils and nasal cavities now and then, the infectious material being aspirated into the lungs, where it becomes implanted, and is followed, from a few days to a week or two later, by an acute abscess. I am led to believe that abscesses having this etiology are more common after tonsil operation than is generally believed. I have seen more than twenty during the past year and a half, and other observers, as Manges² and Richardson,³ report cases which have come under their observation. These abscesses always furnish a history of acute onset; expectoration, sometimes foul smelling, usually profuse at first, varying in quantity later; quite often periodical rises of temperature, and sometimes bloody expectoration. Clubbing of the fingers usually comes on quickly. I have seen it very pronounced in abscess following tonsillectomy in less than three months after the abscess formation, and have noted it as early as six weeks.

The most common form of pulmonary abscess that clinicians deal with today is that which followed the recent influenza epidemic. The abscess is usually found in the lower half of the lung and is often situated in fibrous tissue which has resulted from the infection. Not uncommonly a complicating pleurisy was present which has resulted in pleural adhesions and thickening. Prior to the recent epidemic the type of abscess which was most common in my practice was the one following operations on the upper respiratory tract. It was only occasionally that I saw one following an acute respiratory infection.

Bronchiectasis, as I have observed it, usually follows a pneumonia in childhood, although I have seen it follow the same in a few instances in adolescence and early adult life. It sometimes seems to begin with a bronchitis and persists as a chronic form of this affection. I have rarely seen it begin in those past middle life unless it was of a tuberculous nature. The patient usually gives a history of cough which continued after a pneumonia or after a bronchitis as before mentioned. Oftentimes cough, with expectoration, has persisted since the pneumonia; at other times it has appeared only when the patient had, what was termed a "cold." If the process follows chronic bronchitis it also shows periods of exacerbation. Temperature may be present occasionally and the sputum is at times bloody. The cough in most of my cases has been loose, indicating that the sputum is in the larger tubes, where it is easily moved. The loose nature of this cough itself has proved of diagnostic worth. A history of cough with expectoration, following and persisting after a pneumonia in childhood, is of itself nearly sufficient for the diagnosis of the postpneumonic type. The fingers are often clubbed, but in my experience this sign is not as important as in

² Jour. Am. Med. Assn., May 8, 1915, p. 1554.

³ Abscess of the Lung following Operation on the Tonsils and Upper Air Tract, The Laryngoscope, St. Louis, Mo., July, 1916.

pulmonary abscess. It is neither as constant nor does it appear as quickly.

Pulmonary tuberculosis with cavity gives a very different history. As a rule, the patient forms an abscess cavity of a tuberculous nature only after the disease has existed as a clinical entity for some time, although now and then we see a sudden onset with cavity following in a short time. Occasionally a mistaken diagnosis is made and the acute signs in the lung at the time of the formation of the cavity are taken for pneumonia. A careful study of the clinical history will often aid in differentiating these processes. Cavity formation in tuberculosis is more liable to be preceded by repeated attacks of toxemia sometimes months apart, while pulmonary abscess usually comes on promptly following an acute infection in a patient who was previously in good health. I have seen a few cases of tuberculous abscess form in which the patient had complained of acute illness for only a short time. The patient with tuberculosis as compared with the one suffering from pulmonary abscess or bronchiectasis is more liable to suffer from nerve irritability, and, as a rule, shows a greater degree of nutritional disturbance when the acute process comes on. Repeated attacks of bronchitis are common in bronchiectasis and in tuberculosis, but not in pulmonary abscess.

NATURE OF PROCESSES. Pulmonary abscess is a disease caused by microorganisms which produce acute infections. These organisms are often found in the air passages, as is the case during epidemics of acute respiratory disease. When the abscess follows operation on the upper respiratory tract the bacteria are probably dislodged in large numbers and aspirated directly into the trachea and bronchi. They are capable of ready implantation and rapid multiplication. They follow the direction of the strongest air currents with greatest ease and usually produce their infection in the lower lobes.

Bronchiectasis, being a disease of the bronchi in which dilatation and distortion occur as a result of pathological changes in their walls, often follows fibrosis and contraction of pulmonary tissue. It is commonly found near the hilum, although the affection may involve the bronchi in all parts of the lung.

Pulmonary tuberculosis, being a chronic infection resulting from microorganisms which are not commonly found in the air passages of those who are not suffering from tuberculosis, and which require time for multiplication, is not a disease which results immediately on the bacteria gaining access to the air passages. If the patient has not been previously infected, the bacilli, after entering the tissues pass readily to and settle in the lymphatic glands and are later carried through the blood or lymph stream to be deposited in the capillaries or lymph spaces of the pulmonary tissue. This is the manner in which lung infection most probably takes place. While implantation of the microorganisms which produce the acute infec-

tions is favored by the relatively greater motion and greater force of the air currents in the lower lobes of the lung which force the bacteria deeper into the tissues, the relatively lessened motion of the apex favors implantation of the slowly developing blood and lymph-borne tubercle bacilli; consequently, active tuberculosis with cavity formation is usually first found near the apices while pulmonary abscess is usually found in the lower lobes, and bronchiectasis may be found in any portion, but often affecting the large bronchi near the hilum.

INSPECTION. On careful inspection a diminution of motion will nearly always be noted on the side of the involvement in all of these affections, because all reduce the elasticity of the lung tissue, cause a loss of tissue and produce a reflex diminution of motion through the diaphragm and other muscles of respiration. In pulmonary tuberculosis this may be difficult to ascertain in those instances in which there is a lesion in both lungs. In bronchiectasis the lung involved is practically always contracted and the mediastinum shifted toward that side. In pulmonary abscess, contraction with shifting of the mediastinum may or may not take place, although it usually does if the process is a chronic one. The same is true of tuberculosis.

REFLEX CHANGES IN MUSCLES AND OTHER SOFT TISSUES DETERMINED BY INSPECTION AND PALPATION. The reflex spasm in the muscles and degeneration of the soft tissues—skin, subcutaneous tissue and muscles—is, as a rule, not as marked in pulmonary abscess and bronchiectasis as it is in pulmonary tuberculosis. The extent of the degeneration, when the process has become chronic, depends upon the extent and character of the previous inflammatory process. Pulmonary abscess is a focal infection in the lung. It may be single or multiple, but, as a rule, it appears as an acute disease in tissue which has not been, as is the case with tuberculosis, for a long time previously the seat of widespread foci of infection. Those abscesses which have followed our recent epidemics of acute respiratory infections, however, often occur near the base in the midst of areas of widespread fibrosis of pulmonary and pleural tissue. Bronchiectasis is, as a rule, limited in the amount of tissue involved. Like pulmonary abscess and unlike pulmonary tuberculosis it is rarely found in the midst of numerous active foci of infection. Pulmonary tuberculosis, on the other hand, when it becomes an active clinical process with cough, expectoration and cavity formation, is nearly always a chronic disease and the cavity is formed in tissue which, as a rule, is and usually has been, for a long time, the seat of many foci of infection which have been undergoing all degrees of active inflammation. The result is that pulmonary tuberculosis offers the greatest opportunity for reflexes. The muscles of the shoulder girdle and diaphragm are more tense (increased tension in the latter is inferred from the limited motion) during the activity of the tuberculous process than is found in the other diseases. When the

disease becomes chronic these muscles and the soft structures (skin and subcutaneous tissue) in the neck and down to the second rib anteriorly and the spine of the scapula posteriorly show far more reflex trophic changes in tuberculosis than in the other two diseases. In fact, chronic tuberculosis of the lung may be suspected whenever the neck muscles and the subcutaneous tissue and skin of the neck and chest above the second rib anteriorly and the spine of the scapula posteriorly are markedly degenerated. Pulmonary abscess and bronchiectasis also cause degeneration in these same tissues, but, as a rule, it is not so extensive, and I have seen instances of these affections which caused practically no reflex trophic changes.

PALPATION AND PERCUSSION. Percussion may give little or much information in abscess and bronchiectasis, but is of far more importance in pulmonary tuberculosis. Palpation has been of more aid to me than percussion.

AUSCULTATION. On auscultation the signs elicited in pulmonary tuberculosis with expectoration are usually more or less definite. If a cavity is present in active tuberculosis it is found in the midst of actively diseased tissue, which usually gives rise to characteristic respiratory sounds and many rales; if chronic, the tuberculous process outside the cavity may be partly or wholly healed, under which circumstances the signs elicited on auscultation may be similar to those of pulmonary abscess. The signs of pulmonary abscess and bronchiectasis, as determined on auscultation, are usually few and often very indefinite. In fact, the nature of the process may be suspected from this fact: a definite history of cough and expectoration, usually a fairly large quantity, sometimes even several ounces a day, and comparatively few signs of moisture on auscultation.

EXPLANATION OF DIFFERENT AUSCULTATORY FINDINGS. If the examiner only can form a true conception of why there are marked changes on auscultation in pulmonary tuberculosis, and why even with larger quantities of sputum, as is often the case, there is such an absence of changes on auscultation, in pulmonary abscess and bronchiectasis, then the differentiation of these affections will be easier. This I shall attempt to show graphically by the accompanying illustrations.

The explanation of this fact is based upon the difference in pathology as mentioned above when considering the reflexes which arise from these processes.

Mucous rales or crepitations may or may not be elicited over cavities, depending on whether or not the mucus which they contain is disturbed by the ingress and egress of air. Ronchi are sometimes heard over them. Conditions which favor the production of the most constant and greatest quantity of pulmonary rales are not found in the cavity itself but in the surrounding tissue as noted in pulmonary tuberculosis.

The relative prominence of rales in these three affections may be illustrated by the accompanying figures:

Fig. 1 illustrates the conditions present in pulmonary tuberculosis. A large cavity *A* has formed near the apex. It will be noticed that this has taken place in an area which is the seat of a widespread

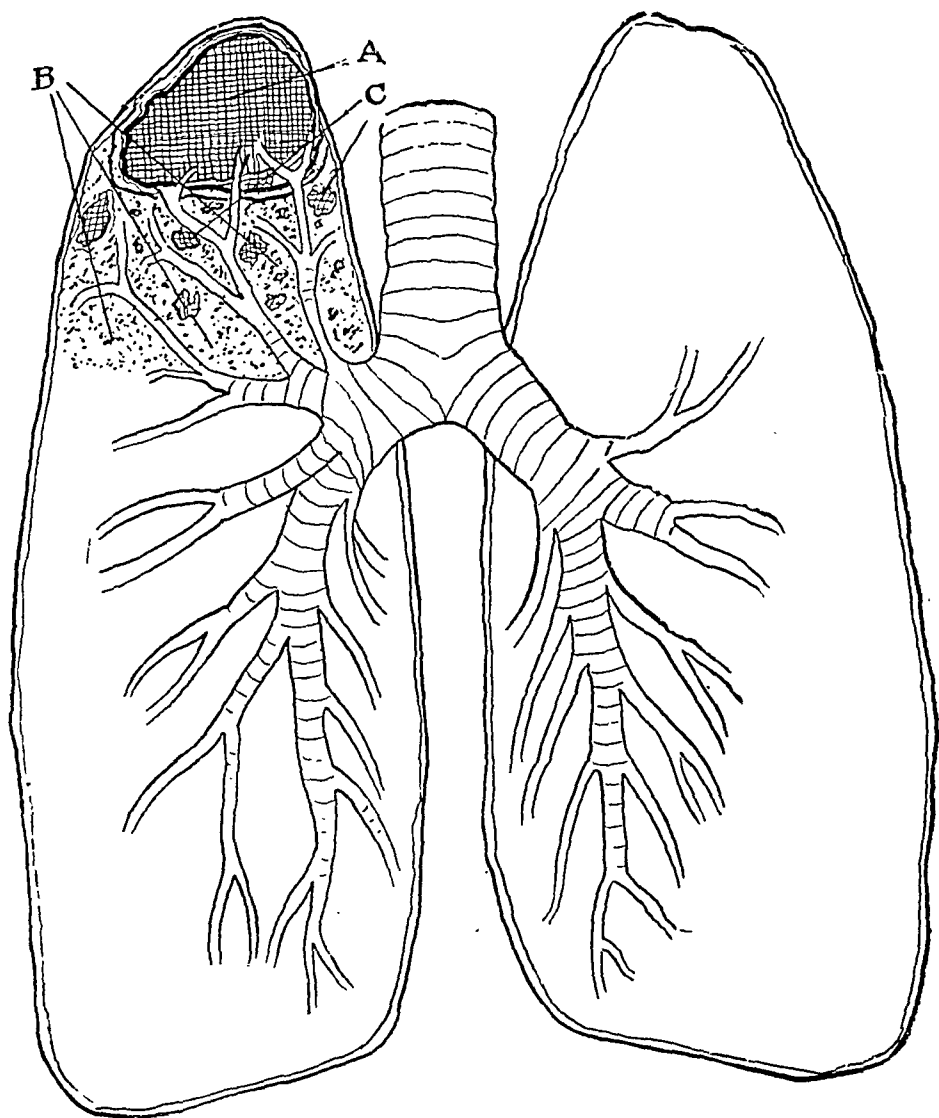


FIG. 1.—Diagrammatic illustration of a cavity due to pulmonary tuberculosis. The cavity, *A*, is surrounded by tissue which is the seat of tuberculous infiltration, *B*, and which contains many small cavities, *C*. These are ideal conditions for the production of rales.

tubercular involvement, as illustrated by the dotted area *B*, throughout which there are numerous small cavities *C*. Here we have the ideal conditions for the production of crepitations and mucous rales: inflammation with foci of necrosis involving the walls of air cells and bronchi accompanied by an increased production of mucus which must find its way toward the trachea through bronchi of all

sizes. The cavity itself is at times the seat of coarse rales, at other times no rales are elicited over it. Not infrequently I have seen the sudden disappearance of rales take place over an area of tuberculous infiltration as a result of cavity formation.

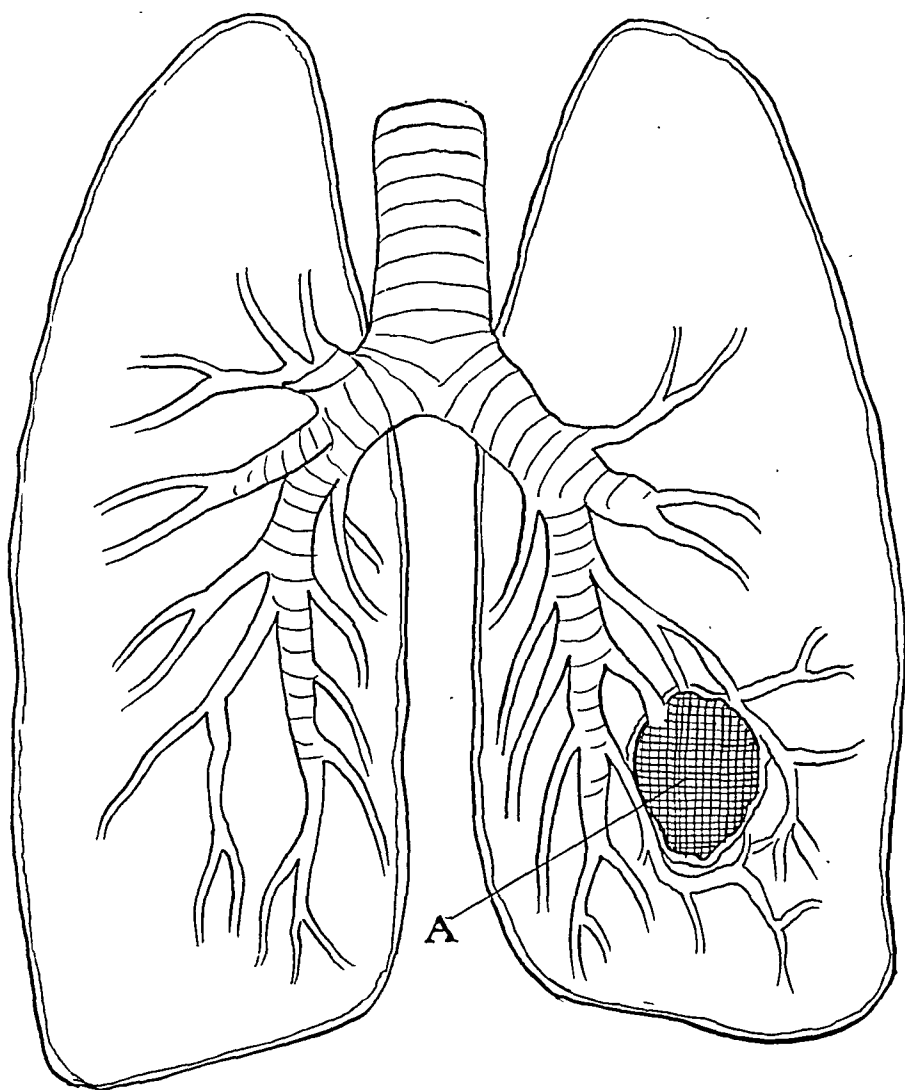


FIG. 2.—Diagrammatic illustration of acute pulmonary abscess. The abscess, *A*, is situated in the midst of and surrounded by healthy pulmonary tissue. The source of rales is the cavity itself and the bronchi leading from it. This condition is not favorable to the production of many rales.

Fig. 2 illustrates the condition present in pulmonary abscess. An abscess *A* has formed as a result of acute bacterial infection. As a rule the first pulmonary abscess which forms is an acute process coming on within a few days after the implantation of bacteria has occurred. The surrounding tissues may not be at all infected. This is particularly characteristic of those abscesses which follow opera-

tive procedure upon the upper respiratory tract. The abscess often forms in a single focus the same as a boil forms on the surface of the body. When the pressure in the abscess becomes sufficiently great, rupture occurs at the point of least resistance, which is usually into a bronchus.

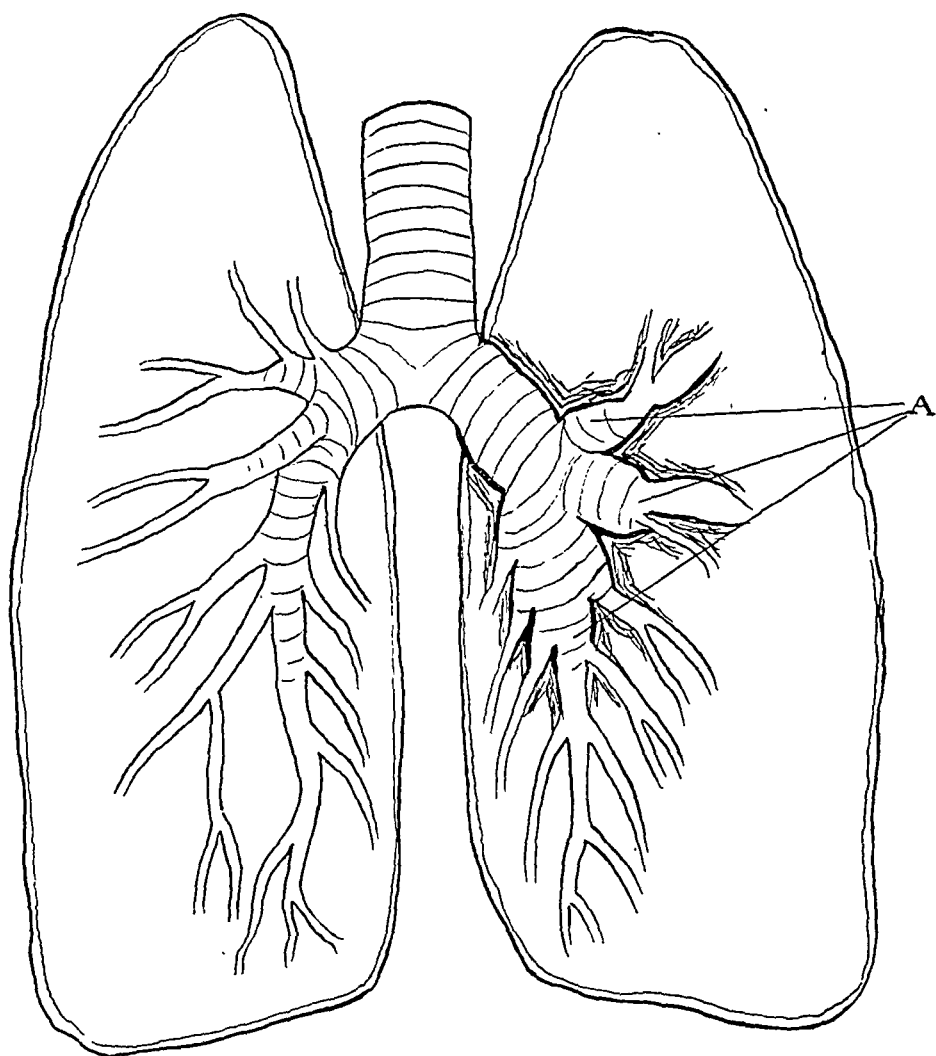


FIG. 3.—Diagrammatic illustration of bronchiectasis. The bronchiectatic dilations A are surrounded by pulmonary tissue which is not the seat of infection, consequently the main source of rales is the mucus which forms in the dilated bronchi. This condition is not favorable to the production of many rales.

A pus-forming pocket remains which discharges through the bronchus. The conditions in the surrounding tissues which favor the production of crepitations and rales as shown in pulmonary tuberculosis in Fig 1 are absent and the chief source of whatever rales may be present is the abscess cavity itself and the bronchus or bronchi which drain it. The result is that crepitations and mucous rales are few in abscess produced by acute infections as compared

with the abscess cavities which accompany pulmonary tuberculosis, unless the latter have existed for a long time and the tuberculous involvement of the surrounding tissue has healed.

When multiple abscesses form in non-tuberculous lesions, as they sometimes do, particularly in those cases which become chronic, each one repeats the same cycle of events as noted in the acute single abscess. Varying amounts of scar tissue result, but still the widespread inflammatory and destructive processes which characterize tuberculosis and which favor so greatly the production of crepitations or mucous rales is absent. If the infectious process in either pulmonary tuberculosis or pulmonary abscess involves the pleura, then crepitations may be present which may be differentiated from pulmonary rales only with the greatest difficulty and sometimes not at all.

Much the same condition is found in bronchiectasis as far as the production of rales is concerned as has just been described in pulmonary abscess. The bronchi are dilated and their walls thickened, as shown at *A* in Fig. 3, in such a manner that the dilatations have much the same physical appearance as abscess cavities. The surrounding tissue is thickened, fibrous in nature and offers little opportunity for the production of crepitations and mucous rales. At times there is constriction of the bronchi proximal to the dilatation which may favor accumulation of secretion and cause sounds on auscultation; but there are rarely heard on auscultation, either in abscess or in bronchiectasis, sounds which will afford any idea at all of the extent or seriousness of the pathological process present.

A history of persistent expectoration of moderate or large quantities of sputum, with a diminished respiratory excursion on one side of the chest and an absence or paucity of crepitations or mucous rales on auscultation over the side affected, should make one think of pulmonary abscess or bronchiectasis. Ronchi are often present, but they too may be absent.

IMMINENT PSYCHOLOGY: A PROPHECY AND A PLEA.¹

BY JOSEPH COLLINS, M.D.,

PHYSICIAN TO THE NEUROLOGICAL INSTITUTE, NEW YORK.

AFTER we have had an encounter that tests our capacity and our endurance we should submit ourselves to examination that we may know our actual and potential strength and worth. After a merchant or a banker has had unusual and testing demands made upon his

¹ Read before the Thirty-fourth Annual Meeting of the Association of American Physicians, held at Atlantic City, June 16, 1919.

stock or his capital, he deems it not only prudent but necessary to take an inventory.

The medical profession of this country has been called upon the past two years to give an account of its competency that tested it to a degree never imagined or anticipated. That it was not found wanting, spiritually or materially, is gratifying: that it was found inadequate in some respects is regrettable. It should be our desire and our duty to surmount the conditions upon which such inadequacy depended. It is meet that we should profit by our experience. We read and we hear it said by surgeons and physicians that we have not learned much from the war, meaning that no new principles in pathology, bacteriology or chemistry have been established or elucidated. But if the war has shown us that our training as physicians is imperfect, and, in some ways, inadequate, we have learned that which may profit mankind far more than the discovery of a new antiseptic or a new treatment of wounds.

I confine my remarks to the department of medicine with which I am identified, neurology, which, of course, I use to include disorder of the mind, emotions, personality, soul—call it what you will.

STATEMENT OF FACT. The medical profession was unprepared to make adequately, properly and expeditiously the examinations which would eliminate from the volunteer and drafted men, actual and potential disorder of the nervous system.

It was incompetent, in a measure, to examine, interpret and treat disorder of the nervous system flowing from war and its entailment.

It is not prepared now to do the work of reconstruction as well as the medical profession of some other countries.

The explanation of this dereliction is (1) the branch of medicine known as neurology has never been properly or adequately taught medical students in this country; (2) the branch of physiology known as psychology has been treated by medical pedagogues and practitioners with scorn and (3) alleged and admitted psychiatrists have not considered it essential to be physicians, diagnosticians, interpretists and therapists first and psychiatrists second.

The war revealed that next to injury and general medical diseases, disorder of the mind and nervous system was the most incapacitating disease of soldiers. It convinced the medical personnel of the army that training in neurology and psychiatry was essential if the average Medical Corps man was to do his work properly. The experience of neurological and psychological examiners at officers' training camps and at cantonments showed that large numbers of enlisted and volunteer men, officers and soldiers were of such intelligence that they were not fitted for officers or soldiers and that many actual and potential nervous and mental diseases were to be detected by careful examination. Out of one million seven hundred thousand men examined by psychological tests, approximately forty-seven thousand were found to be the

mental age of ten. From 3 to 5 per cent. of the men in officers' training camps were found to be afflicted with some form of nervous or mental disease that either incapacitated them or would incapacitate them under stress.

The importance of neurology in medical practice in the war is convincingly illustrated by the experience of France and England. For three generations France has had neurological schools through which large numbers of its physicians passed and in which they learned the fundamental principles of neurology and became familiar with cardinal methods of examination. As the result of this the medical profession in France was so enlightened that they were able to provide two important regulations in the matter of shell shock: (1) that victims of that so-called neurosis were not pensionable, and (2) that its occurrence was not an adequate cause for discharge from military service. This enlightenment of the medical profession of France saved many thousands of soldiers and millions of francs for that country. On the other hand, neurology in England has never had extensive recognition by the general practitioner. As the result, she has some twenty-five thousand men who are pensioned, invalid soldiers, most of whom were recoverable if they had been properly diagnosed and treated.

THE PROPHECY. We are now on the threshold of an era in which psychology is going to be applied to the problems of mundane life: work, occupation, recreation; the spiritual, physical, social, financial, hygienic betterment of mankind, including ourselves.

Within a generation admission to high schools, colleges and universities will be obtained, in great measure, by passing a psychological examination. It will be obtained by determination of the candidate's intelligence and his emotional reactions, and not by determination of how much Latin or Greek, algebra or history, he has been able to memorize.

Within the same period anyone seeking a position of responsibility or that requires for its satisfactory performance intelligence will be required to pass a psychological examination, and upon that examination will depend largely the fate of the individual.

The choice of profession, occupation or career will be determined largely by psychological examination of the individual. In this way misfits will be prevented. Men and women adapted to the church will not go into medicine; those adapted to the stage will not go into finance; potential statesmen will not strive to be scientists.

Fitness for taking on work that requires for its successful accomplishment attention, energy, vision, imagination and any constructive mental quality will be determined by psychological and physical examination. Civil service examinations will no longer consist of geography, history, algebra and similar subjects; entrance to the diplomatic service will not depend upon knowledge obtained from

books; promotion or advancement in any intellectual field will not be dependent upon feats of memory. They will be determined by psychological examination of the individual seeking position and preferment.

The next great move that pedagogy will make will be in the field of psychology. There will be a radical change in the present method of grading schools. The grading of pupils will soon be done by determining the constitution of the pupil's mind, its potentialities, the trend and capacity of its contents. Children who have aptitudes, special qualities of mind or emotion will be grouped, while others lacking these but possessed of equally meritorious mental and emotional qualities of a different kind will be classed in another group, and they will be subject to different kinds of instruction.

Vast sums of money will be saved taxpayers and great numbers of individuals will be saved lives of incompetency and ignominy by the utilization of the facts that have today been established by psychology. Potential psychoneurotics will be recognized before deforming and incapacitating nervous and mental symptoms appear; the feeble- and tender-minded will be detected at a time when developmental measures may be applied with hope of success; and those from which are recruited cranks and criminals, prostitutes and wastrels, drunkards and hoboos will be recognized to be the legitimate care of the State and of the individual, whose combined effort must be to assist them to approximate normality before they have, by accident or design offended law or convention.

Many chronic diseases and much semi-invalidism which cannot be specifically designated depend upon disorder of internal secretions—that is, upon disturbed functions of glands controlled and regulated by the nervous systems and which develop and operate in connection with the emotions.

Health, resistance to disease, mental and emotional endowment, the things that make life worth living, are as intimately bound up with the origin and development of the sympathetic nervous system, and this in turn with instincts and emotions, as man is bound up with original sin. The physician who seeks to interpret them and prevent them thrusts a great handicap upon himself by ignoring these facts, and he who devotes his life to ameliorating or attempting to cure disease handicaps himself tremendously by not hearkening to the revelations of the science of psychology.

Medicine is about to be quickened, revived and enriched by doing teamwork with the science of psychology. Though the prevention of disease is, and must always be, the goal for which its votaries strive, the amelioration and cure of disease will continue to engross the vast majority of them. Psychology will, however, be utilizable in both fields. Already the man of affairs, the man of big business, is utilizing it by means of a new type of efficiency expert, the social and psychological engineer.

Preventive medicine must concern itself with the individual as well as with the germ. Resistance to disease may be partly a question of chemistry, but it is largely a question of emotions and psychophysical elaborations whose potency may be determined, and their existence influenced, by the physician versed in psychology.

To dwell upon the effect of mind upon matter before this audience, or to dilate upon the influence of mind upon disease in a country in which supernaturalism thrives so luxuriously as it does in this country, would be absurd. We physicians are about to be compelled to use forces scientifically which innumerable "ists" have used, and are using with success, empirically.

THE PLEA. The members of this Association are the medical teachers of the country, or the material from which the dominating medical teachers are recruited. It is to them that the rank and file of the profession, and the laity conscious of hygienic and social awareness, look for inspiration, guidance, initiative and accomplishment. They are the tone that makes the Esculapian music.

I appeal to you, therefore, to treat neurology as a legitimate child, worthy not only of parental affection and understanding, but entailing the obligation of development and maintenance, of fullest and most intimate admission to the family medical circle.

It would be no more absurd to maintain that a physician could be competent who was ignorant of physiology than it would to claim that one could be a competent neurologist who had not a comprehension of psychology. Psychology should be hailed with the warmth that chemistry was a generation ago. It gives promise of results equal to or surpassing those obtained by the physiological chemist.

Psychology should be taught medical students or a comprehensive familiarity with its fundamental principles should be demanded of those who knock at the portals of medicine as a career. Psychiatry should be taught in medical schools as physiological pathology and as a division of internal medicine—one of the most important divisions. The psychiatrist should be a thoroughly trained physician who has a bias toward or flair for psychology. The training in medicine should give him perspective; the training in psychology, penetration; and both should give judgment of fundamentals, which in physicians is often spoken of as insight, perspicacity, awareness—qualities essential to the real physician.

The successful physician of the future must make a biological study of human nature and of instinct if he would fulfil his privileges and discharge his duties. In no other way can he compete with the empiricists, supernaturalists and neoplatonists who have reaped such harvest in this country at the expense of the victims of incapacitating disorder of one or more of the bodily functions masquerading as disease of the nervous system.

To give such training there must be hospitals and laboratories

as well as teachers. The unstudied, uninterpreted material in general hospitals and the casual, transitory material of the dispensary is neither appropriate nor adequate. We must have hospitals for the study and interpretation of nervous diseases in connection with every school in which medicine is properly taught.

The career of the Neurological Institute of New York is an earnest of the need of such hospitals, and the service it rendered this country in giving rapid, intensive training to upward of three hundred physicians which would endow them with a measure of the capacity to handle the neuropsychiatric problems presented by the war is the reward of its founders.

The present proud position of the science of medicine is attributable to one factor—the laboratory. The elimination of disease by preventive measures has, in a measure, been accomplished by it and will continue to be accomplished by it. No less than twenty-five diseases are diagnosed with certainty by laboratory methods and the recognition of at least a score of others is assisted and facilitated by it.

Laboratory methods receive greater emphasis in medical education than any others. The psychological laboratory only is neglected and yet the technicians of the psychological laboratory made one of the important contributions of medicine in the Great War by the formulation of methods of mental and emotional measurement which permitted elimination of men unfit to contribute to military success while facilitating proper placement of officers and soldiers.

We cannot hope, nor would it be desirable, to make physicians into psychological laboratory technicians. The latter must be the assistant to the physician, just as the bacteriologist, the chemist and the photographer is. He must be the expert coöperating with the physician. They must do teamwork. They cannot do it if the physician balks, and instead of pulling, expends his strength in scorning the psychologist. The physician must be the judge of the psychologist's work—he must test it and he must know how to utilize it for the benefit of the sick.

It is not sufficient that the leaders of medical thought and the makers of the pace of medical efficiency shall say that they are ready and willing that the psychologist shall show them what he can do. They must do with the principles and formulation that he furnishes that which they did with those discovered and formulated by Pasteur.

Neurology and psychiatry must be properly taught in this country if American medicine is to get and maintain the place which it deserves. To accomplish this three things are necessary: (1) teachers; (2) hospitals; (3) the sympathetic atmosphere. The last is vital. I appeal to this organization to furnish it.

**BRONCHIECTASIS: ITS DIFFERENTIATION FROM
PULMONARY TUBERCULOSIS.**

By B. STIVELMAN, M.D.,

MEDICAL SUPERINTENDENT, MONTEFIORE HOME COUNTRY SANATORIUM, BEDFORD
HILLS, N. Y.

(From the Tuberculosis Pavilion of Montefiore Home and Hospital, New York City,
and Montefiore Home Country Sanatorium, Bedford Hills, N. Y.)

THE importance of detecting pulmonary tuberculosis in its early stages has frequently and justly been dwelt upon, but many patients exhibiting symptoms and signs suggestive of advanced disease of the lungs have often been denied a careful investigation of the nature of their affection. The multifarious lung lesions produced by the tubercle bacillus and the extreme variation in the clinical course of any given group of cases have often influenced us to attribute signs, in the lungs deviating from the normal, to phthisis pulmonalis, the common disease, when in reality such signs, when carefully analyzed, after the history of the case is accurately ascertained, are found to be due to pathological changes, non-tuberculous in character.

In view of the growing tendency to isolate the "advanced consumptive," such cases have frequently been banished to hospitals for the tuberculous or to distant climatic health resorts, at great expense and inconvenience, branded with the stigma of tuberculosis before the nature of the disease in their lungs had been definitely determined.

To obviate such occurrences, many authors have, in recent years, emphasized various chronic lung affections simulating pulmonary tuberculosis. Some observers call attention to chronic non-tuberculous lung infections involving the lower lobe of either or both lungs; others describe conditions affecting the upper lobe. Syphilis of the lung is mentioned as a possible but rare source of error, and it has also been shown that chronic bronchitis and heart conditions at times give rise to moisture on auscultation, diminished resonance on percussion and subjective symptoms, such as cough, expectoration, etc. Yet surprisingly little has been said of bronchiectasis, although this disease resembles certain types of pulmonary tuberculosis most closely.

Bronchiectasis, it is true, will rarely if ever be confused with acute progressive phthisis, which runs a rapidly wasting course, with chills, fever, sweats, emaciation, etc.; but it will, with difficulty, be differentiated from that form of tuberculosis characterized by mild constitutional symptoms, little or no wasting, with physical signs suggestive of marked fibrosis. Indeed, the resemblance of bronchiectasis to such cases of phthisis pulmonalis is so great that

unless careful observation is afforded for a considerable length of time, and all modern diagnostic methods are applied, a differential diagnosis may be impossible. The cases of bronchiectasis which form the basis of this communication are a few of those sent to us as "advanced consumptives," and are reported in these columns with the intention of demonstrating the salient points that help us in the differential diagnosis.

Among the more difficult to diagnosticate are those cases in which careful thermometry reveals an elevation of temperature in the afternoon hours. The fever, together with the cough, expectoration and blood-streaked sputum, are frequently considered to be due to tuberculosis. It must be pointed out, however, that afternoon temperature is not uncommon in the older bronchiectatics and in those who, enfeebled for various reasons, do not efficiently expel their bronchial contents. In order to arrive at a definite diagnosis in such cases a painstaking analysis of the clinical history and repeated physical and sputum examinations are essential. The history will most usually disclose absence of early constitutional symptoms of toxemia and fair health in spite of distressing cough and profuse expectoration; the physical examination will reveal a unilateral lesion, most frequently involving one of the lower lobes. Repeated examination of the sputum will not show the presence of tubercle bacilli. The following case illustrates these points very clearly:

CASE I.—Late bronchiectasis, with mild constitutional symptoms, due to retention of secretion, with autopsy findings.

S. B., aged fifty-six years, housewife, admitted October, 1916. She had measles and cholera in infancy, pneumonia at six years of age and again three years before admission. She had frequent attacks of "la grippe" since her last illness.

Present Illness. Since the pneumonia, three years ago, the patient has been subject to frequent colds, with more or less constant cough, which gradually became more and more distressing. Expectoration, at first scanty, became profuse and pain was soon complained of in the lower part of the right chest posteriorly. For the last fourteen months her sputum has at times been blood-streaked; she lost twenty pounds in weight and has been suffering from marked shortness of breath. On physical examination we found a fairly well-nourished individual; the cheeks, lips and finger-tips were slightly cyanosed; the fingers were clubbed and the nails markedly curved. The right chest was somewhat retracted in the supra- and infraclavicular spaces; slight atrophy of the muscles of the right supraspinous fossa was also noticed. Physical exploration of the chest showed very markedly impaired resonance throughout the entire right chest, the note being flat in the region of the lower lobe. Breath sounds were bronchial over the upper half of the right chest, both anteriorly and posteriorly, and cavernous

over the middle lobe. Throughout the right lung large, moist, consonating rales were heard and whispered pectoriloquy was elicited over the middle lobe. The left chest was emphysematous.

While at the hospital her cough increased in severity, expectoration averaging 450 c.c. in twenty-four hours; it was fetid and separated into three distinct layers on standing. Her temperature frequently rose to 101° in the afternoon, but the pulse was only slightly accelerated. On numerous examinations of the sputum tubercle bacilli could not be found. The urine was negative. The Wassermann reaction of the blood was negative; blood-pressure was 118 systolic and 86 diastolic.



FIG. 1.—Patient B. S. Left lung: Marked hilus changes; otherwise negative. Right lung: Diffuse infiltration throughout the lung most marked at the middle lobe with evidence of a great many dilated bronchi. Heart moderately enlarged and slightly pulled to right. Arch of aorta moderately dilated. Evidence of pleuropericardial adhesions.

Roentgen-ray examination (Fig. 1) disclosed marked hilus changes in the left lung; otherwise negative. Right lung: diffuse shadow throughout the entire lung, most marked at the middle lobe, with evidence of a great many dilated bronchi. Heart was moderately enlarged and slightly pulled to the right. The arch of the aorta was moderately dilated. Right diaphragm elevated and evidence of pleuropericardial adhesions was noted. Interlobar fissure was thickened.

Because of the history of pneumonia immediately preceding the present complaint the absence of fever in the early stage of the

disease, comparatively slow pulse, the profuse and periodically fetid expectoration, fair nutrition, with a history of cough of three years' duration, the negative findings in the profuse expectoration and the absolute unilateral involvement more marked at the lower lobes, a diagnosis of bronchiectasis was made and the patient was transferred to a non-tuberculous ward of the hospital. Here she grew progressively weaker, began to show signs of right heart insufficiency and died eight months after admission.



FIG. 2.—Patient B. S. Note the various-sized cavities throughout the lung. One large cavity communicates with a bronchus (split open) at the middle lobe.

Postmortem examination revealed the following condition: A few pleural adhesions in the left lung; otherwise negative. The right pleura was markedly thickened, and very firm and thick adhesions caused the lung to be separated with great difficulty from the chest wall. The right lung (Fig. 2) weighed almost three times as much as the left and was firm and hard in consistency.

The whole lung appeared to be studded with cavities, the walls of which were smooth and glistening. They had no fixed capsule and invariably communicated with bronchi. On slitting the bronchi it was evident that these cavities were true bronchial dilatations. Active tuberculous lesions could neither be found macroscopically nor microscopically.

BRONCHIECTASIS COMPLICATED BY PLEURAL EFFUSION. Pleural effusion is one of the most frequent complications of pulmonary tuberculosis. Indeed, in doubtful apical lesions the occurrence of an effusion frequently clinches the diagnosis of tuberculosis, whether or not tubercle bacilli are found in fluid aspirated either microscopically or by animal inoculation. But an effusion superimposed on a pulmonary lesion in the lower lobes is not necessarily tuberculous. Carcinoma of the lungs and at times bronchiectasis may be complicated by such effusions. The diagnosis in such cases is not impossible when it is remembered that tubercle bacilli are invariably present in the abundant sputum of the far-advanced tuberculous in whom physical findings reveal marked activity of the process. In the bronchiectatic the abundant fetid sputum is free from tubercle bacilli.

Furthermore, it is exceedingly rare to find a unilateral far-advanced tuberculous lesion, while bronchiectasis is most frequently unilateral and almost always involves the lower lobes. Pulmonary osteo-arthritis is most marked in bronchiectasis and the general health of these patients suffers but little in spite of the distressing cough and profuse expectoration of many years' duration. The following case illustrates the points discussed most distinctly:

CASE II.—M. K., aged forty-seven years, real estate broker, admitted October, 1916.

Family and previous personal history have no bearing upon his present trouble. For the past twelve years he has been coughing and expectorating, but never had constitutional symptoms, such as chills, fever, sweats, nor did he have hemoptysis. He did not lose weight. Four years ago he became acutely ill with pneumonia and pleurisy. He was in bed for two weeks and then improved rapidly. The cough, however, did not lessen in severity, but was even worse after convalescence. Eight months after his pneumonia his sputum became fetid in character and quite abundant; it was expelled in paroxysms and in large quantities. He had a few slight attacks of hemoptysis and noticed that when the amount of sputum diminished fever made its appearance, especially toward evening. He lost considerable weight and strength. His chief complaint has been dyspnea.

On physical examination the patient was found to be markedly cyanosed. His drumstick fingers were cyanotic and his breathing was very hurried. The right supraclavicular fossa was markedly

depressed. On percussion the right chest was dull throughout, with the exception of the base where the note was flat. Bronchovesicular breathing and a few crackles were elicited over the right apex; cavernous breathing and whispered pectoriloquy and many moist gurgling rales were heard from the second rib down, excepting over the area of flatness, where neither breath sounds nor adventitious sounds were audible. Left chest was apparently normal. Pleural effusion was diagnosed and fluid aspirated from the right pleural cavity and injected into a guinea-pig, which did not develop tuberculosis in eight weeks.

During his stay at the hospital his sputum averaged over 500 c.c. in twenty-four hours, constantly negative for tubercle bacilli. His urine was negative. He died with symptoms of bronchopneumonia two weeks after admission.

This patient gave a typical history of bronchiectasis following a pneumonic process engrafted upon chronic bronchitis. The many negative sputa and guinea-pig inoculations, the profuse and fetid expectoration, strictly unilateral involvement, the fair state of nutrition in spite of the long duration of infection, the absence of early constitutional symptoms, all pointed toward bronchiectasis as being the condition existing.

Roentgen-ray examination was of little assistance in this case, since it showed a homogeneous shadow throughout the right lung, denser at the base. It is true that in the later months the affection in this case may have been easily mistaken for pulmonary tuberculosis, complicated by pleurisy with effusion, an effusion into the pleural cavity in cases of bronchiectasis; however, is by no means infrequent.

BRONCHIECTASIS WITH PROFUSE RECURRENT HEMOPTYSIS. Hemoptysis is the most discouraging single symptom of pulmonary tuberculosis. It is also at times the first and only symptom of phthisis. Indeed, it is frequently alluded to as the pathognomonic symptom of this affection. But those who treat many pulmonary patients have seen fatal cases of hemoptyses of non-tuberculous origin, many of which were confirmed by anatomical investigation. Hemoptysis occurs almost as frequently in bronchiectasis as in pulmonary tuberculosis. The concomitant marked pulmonary osteo-arthritis, the lack of constitutional symptoms in the early period of the disease, the negative findings in the sputa, the exclusive unilateral and lower lobe involvement, clear apices on roentgen-ray examination, the comfortable and active mode of life in spite of the long duration of the disease, will point toward bronchiectasis as being the condition existing. The following case illustrates the points above mentioned most vividly:

CASE III.—A. A., aged twenty-one years, male, admitted February, 1914. Father and one brother are suffering from chronic recurrent hemoptyses, cough and expectoration. He had pneu-

monia at nine months and again at fifteen months of age. Since the second attack of pneumonia the patient has been coughing more or less constantly, more severely during the spring and fall, but growth was not retarded and his health was generally fair until he reached the age of ten years, when during a fit of coughing he noticed blood in his sputum. He therefore dates his present illness since that time. His main complaints at the time of admission are copious hemorrhages, frequently and regularly recurrent, cough and expectoration more marked in the spring and fall. He appears well nourished. His temperature, pulse and respiration are invariably normal. On admission the only physical signs elicited in the chest were dulness, with diminished respiratory murmur over both bases.



FIG. 3.—Patient A. A. Note clear apices. Marked hilus changes radiating into both lower lobes; more marked on right. Evidence of shrinking process affecting left lung; most marked at the lower lobe. Heart enlarged and probably pulled to left.

While at the hospital the hemorrhages continued. His fingers became markedly clubbed, cough and expectoration appearing at irregular intervals, but his general condition remained unaltered, his weight stationary and repeated sputum examinations proved negative for tubercle bacilli. The urine was negative; the Wassermann reaction was negative.

Roentgen-ray plate showed clear apices, marked hilus changes radiating into both lower lobes, more marked on the right. Evi-

dence of shrinking process affecting the left lung most marked at the lower lobe. Heart enlarged and pulled to the left.

During October, 1916, large moist rales were found at the left base following a hemorrhage. At this time, in view of his clubbed fingers, profuse and at times fetid expectoration, large moist rales, impaired resonance and feeble breath sounds in the left base, the fact that his body was well preserved, the negative examination of his sputa, the negative Wassermann reaction, the absence of ray fungus in the sputum and the absence of definite constitutional symptoms, a diagnosis of bronchiectasis was ventured.

In February, 1917, a bronchoscopy was performed by Dr. Sidney Yankauer, who gave the following report: "Right bronchus is normal; left bronchus is longer and broader. An abundance of pus seems to come only from the left lower lobe, the bronchus of which is filled with thick mucopus. After the removal of the pus, dense tissue closes the bronchus, which probably was granulation tissue."

The sputum at the present time averages 100 c.c. in twenty-four hours, has a somewhat sweetish odor and is still free from tubercle bacilli. Profuse hemorrhages recur regularly and there is a marked freedom from constitutional symptoms.

The latest roentgenogram (Fig. 3) shows marked hilus changes radiating into both lower lobes, with evidence of a shrinking process in the left lower lobe. The apices apparently normal.

BRONCHIECTASIS INVOLVING UPPER AS WELL AS LOWER LOBE. Signs of excavation elicited over an upper lobe are almost invariably due to pulmonary tuberculosis. Pulmonary abscess is at times encountered, but is very rare indeed and can be diagnosticated with little difficulty. Upper lobe bronchiectasis is exceedingly rare and a differential diagnosis from phthisis pulmonalis requires a careful study and a long period of observation. The abundant and at times fetid sputum free from tubercle bacilli, the long duration of the disease without interfering with the working capacity of the patient and the absolute unilateral involvement, the absence of constitutional symptoms of toxemia and the marked osteo-arthritis all speak in favor of bronchiectasis. Guinea-pig inoculation of the sputum in question is of great value while roentgenological examination may help but little. The following case illustrates the points above discussed:

CASE IV.—L. C., aged thirty-seven years, tailor, admitted January, 1915.

Family and previous personal history unimportant.

Present Illness. Began with cough and expectoration following pneumonia at the age of ten years, but in spite of this he worked until two years before admission to this institution, when he was suddenly taken ill with chills, fever, cough and expectoration, which lasted about one week. The condition was diagnosticated as phthisis at a sanatorium for the tuberculous.

Physical examination on admission showed a well-nourished man, dusky in appearance, suffused expression, nose bulbous, eyelids puffy, markedly clubbed fingers, cyanosed nails and marked evidence of pulmonary osteo-arthropathy. The pulse was 75 per minute. The left chest was somewhat retracted, especially at the base, lagged on respiration and showed very limited expansion on deep inspiration. Supra- and infraclavicular fossæ were retracted on both sides, more so on the left. The entire left chest was markedly dull on percussion and resonance at the right apex was slightly impaired. Cavernal breathing and many moist rales were heard over the upper lobe on the left side, and feeble breathing, with few crepitant rales, over the lower lobe. Whispered pectoriloquy was very marked over the left upper lobe. Few scattered dry rales were discerned on the right side over the third and fourth interspace near the sternum.

While at the hospital the patient never showed any evidences or constitutional symptoms of toxemia. His pulse was never above 85; his weight was stationary; his cough moderate, but his expectoration averaged 475 c.c. in twenty-four hours, separating into three layers on standing, now and then foul-smelling. No tubercle bacilli could be found on forty-five examinations, many of which were made with antiformin; but streptobacilli, *Streptococcus hemolyticus* and *Micrococcus catarrhalis* were found. A guinea-pig injected with 10 c.c. of the sputum, and killed eight weeks later, showed no evidence of tuberculosis.

We may interpolate that, curiously, the tuberculosis complement-fixation in this case was 2 plus; blood-pressure 117 systolic and 75 diastolic; urine showed evidence suggestive of chronic parenchymatous nephritis. The Wassermann was repeatedly negative. He received ten injections of autogenous vaccine without any noticeable improvement. The patient finally left the hospital to seek employment.

Roentgen-ray plate showed a homogeneous shadow occupying the entire left chest, with suggestion of extensive vomica formation at the second interspace anteriorly, mediastinal organs markedly pulled to the left. The right lung was apparently clear.

This case was diagnosticated as bronchiectasis because of the following: Good nutrition, although coughing for twenty-seven years, marked pulmonary osteo-arthropathy, absence of constitutional symptoms of toxemia, such as afternoon fever, sweats and tachycardia, profuse and fetid expectoration, negative sputum on examination and guinea-pig inoculation, and absolute unilateral involvement, as disclosed on physical and roentgenological examination. It is true that on superficial examination the physical signs were strongly suggestive of pulmonary tuberculosis, but bronchiectasis may involve upper lobes as well as lower lobes, while unilateral lesions in old cases of tuberculosis are extremely rare. In this

case it is most probable that the pathological changes in the lung involved were primarily due to thickened pleuræ following pneumonic processes, causing at first pulmonary fibrosis and ultimately bronchial dilatation.

BRONCHIECTASIS COMPLICATED BY ENDOMYOCARDITIS. In sanatoriums for the early tuberculous, especially those who have a large proportion of "sputum negative" cases, it is not uncommon to find cardiac cases, usually mitral disease, who have erroneously been sent there for treatment. These usually give a history of blood-streaked sputum, loss of weight, cough and perhaps slight afternoon temperature. When the signs in the lungs suggest the existence of an extensive lesion these are considered to be due to tuberculosis, the patient placed in the category of the "few cardiacs with tuberculosis," in spite of the negative findings in the sputum and absolute unilateral involvement.

Bronchiectasis and organic cardiac disease frequently coexist, and under the circumstances a diagnosis should be easily arrived at.

The following case will bring out these points.

CASE V.—R. G., janitress, aged thirty-five years, married, admitted October, 1917.

Family History. Negative. She had rheumatism at fourteen.

Present Trouble. Began about ten years ago, with cough and expectoration following pneumonia. These symptoms, while mild at first, gradually increased in severity, so that cough is now distressing and expectoration has been profuse for the past three years, and at the present time averages about 300 c.c. in twenty-four hours. There is no history of hemoptysis, chills, fever, sweats or loss of weight, although there is marked dyspnea on exertion. She gave birth to four children since the onset of the disease and apparently childbirth did not materially affect her.

On examination the patient seemed to be well nourished, but had clubbed fingers, respiration hurried, her lips, cheeks and fingernails were cyanosed, marked scoliokyphosis to the right; diminished resonance throughout the right lung and marked amphoric breathing and whispered pectoriloquy over the right middle lobe, harsh breathing and increased transmission of voice sounds over both bases. Numerous large, moist, consonating rales were very audible over both lower lobes. The heart was enlarged to left and right, and a loud systolic murmur at the apex transmitted to the left axilla and a systolic blow at the aortic area were clearly audible.

While at the hospital the temperature and pulse remained fairly normal, but the cough and expectoration were distressing, sputum averaging 300 c.c. in twenty-four hours. Repeated examinations of the sputum did not disclose the presence of tubercle bacilli. Roentgenogram showed advanced fibrosis involving practically the whole right lung, more marked at the base.

In view of the long duration of her illness, the fact that four preg-

nancies did not aggravate her condition, the absolute unilateral involvement, most marked at the lower lobe, and the negative findings in the sputum, a diagnosis of bronchiectasis was made. The organic cardiac condition and the absence of all symptoms of toxemia in spite of the profuse expectoration and distressing cough practically rules out phthisis pulmonalis.

BRONCHIECTASIS IN YOUNG ADULTS. In ordinary sanatorium practice one is particularly impressed with a group of cases which could be classed among the "fat tuberculous," but present a clinical history and physical signs entirely incompatible with pulmonary tuberculosis. These patients are between the ages of fourteen and sixteen years, give a history of cough and expectoration of many years' duration following a pneumonia or pleurisy. They are usually well nourished, in fact somewhat overweight, active and happy. They deny such constitutional symptoms of toxemia as chills, fever, sweats and tachycardia, which are most marked in the tuberculous of this age. They present a suffused expression, puffy eyelids, bulbous nose and markedly clubbed fingers, and physical examination discloses an extensive involvement of one of the lower lobes, with evidence of sacculation and cavity formation and a great deal of moisture. Their sputum is fetid and abundant, brought up in mouthfuls periodically, and is free from tubercle bacilli.

A differential diagnosis in such cases is not difficult if we bear in mind that the young tuberculous, with involvement of the lower lobes, are hectic, emaciated and soon moribund, and tubercle bacilli are invariably present in their profuse expectoration. In such cases both upper lobes are also extensively involved and a definite history of toxemia is invariably given. On the other hand, patients suffering from bronchiectasis are well nourished, comfortable, active, give no history of toxemia, show no evidence of upper lobe involvement, their extensive lesion is at either lower lobe but almost always unilateral and their profuse expectoration is free from tubercle bacilli. Roentgenographic examination, although it will not show more than indefinite shadows at the site of the lesion, will almost invariably disclose clear apices. Bronchiectasis in these cases is the end-result of chronic shrinking processes, due to thickened pleuræ of non-tuberculous origin or interstitial pneumonia. The following four cases are a few of the many cases under our observation, which illustrate the points discussed above:

CASE VI.—S. M., female, aged fourteen years, admitted March, 1915.

She had diphtheria at three years and lobar pneumonia in the left lung at eleven years, which did not end by crisis.

PRESENT ILLNESS. Began with pneumonia three years ago, which was followed by persistent cough and expectoration and gradual development of dyspnea on exertion. She did not have

such constitutional symptoms as recurrent chills, fever and sweat, gained in weight normally, but noticed blood-streaked sputum at times, and was aware of the fact that her fingers became clubbed.

On physical examination we found a well-nourished young girl, cheeks, lips and nails slightly cyanosed, fingers markedly clubbed. Left chest lagged on respiration and there was marked retraction in the supra- and infraclavicular spaces. A dull percussion note was elicited on the left chest from the third space to the base anteriorly, and from the inferior angle of the scapula to the base posteriorly the note was very dull. The left apex, however, was apparently clear. Over the dull area large moist consonating rales could be heard both anteriorly and posteriorly, and bronchial breathing and whispered pectoriloquy could be discerned from the angle of the scapula to the base. The heart was pulled somewhat to the left. The right apex showed mild impairment of resonance and harsh breathing. A roentgenogram disclosed increased density of both roots, radiating into both lower lobes, more marked on the left side.

While at the institution the patient had recurrent attacks of slight hemoptysis; the pulse and temperature, however, were about normal; blood-pressure was 95 systolic and 65 diastolic. Urine and Wassermann reactions were negative. Weight remained stationary. Sputum was profuse and at times fetid, and numerous examinations for tubercle bacilli were negative.

In view of the extensive unilateral lower lobe involvement the absence of constitutional symptoms, such as chills, fever, sweats and tachycardia, good nutrition and fair health, in spite of the persistent cough and expectoration, the negative Wassermann reaction, the negative results on examination of the sputum, a diagnosis of bronchiectasis was made.

CASE VII.—F. B., aged fifteen years, admitted September, 1918. The patient had pleurisy and pneumonia in infancy.

On admission, complained of cough and expectoration of many years' duration. About six months prior to admission the patient realized that her cough had gradually become more distressing and expectoration more abundant and at times fetid and that her fingers were markedly clubbed. Pain in the left chest was also complained of. No history of constitutional symptoms of toxemia could be obtained.

On examination we found a well-nourished, robust young girl, slightly cyanosed, with bulbous nose, suffused expression and puffy eyelids. Her fingers were markedly clubbed. Left chest lagged on respiration and distinct signs of sacculation or cavity formation, with numerous large moist rales, were elicited over the left lower lobe anteriorly and posteriorly. Her heart was pulled to the left. Right lung was negative.

While at the hospital the patient had numerous slight attacks

of hemoptysis; cough was distressing. Sputum averaged 180 c.c. in twenty-four hours and was at times fetid. Her temperature, pulse and respiration remained normal. The sputum was free from tubercle bacilli. The urine was negative. Von Pirquet was slightly positive on two occasions and tuberculosis complement-fixation was 2 plus. Roentgenological examination (Fig. 4) revealed dense shadow in the region of the left lower lobe, with heart pulled to the left, but the apices were clear.

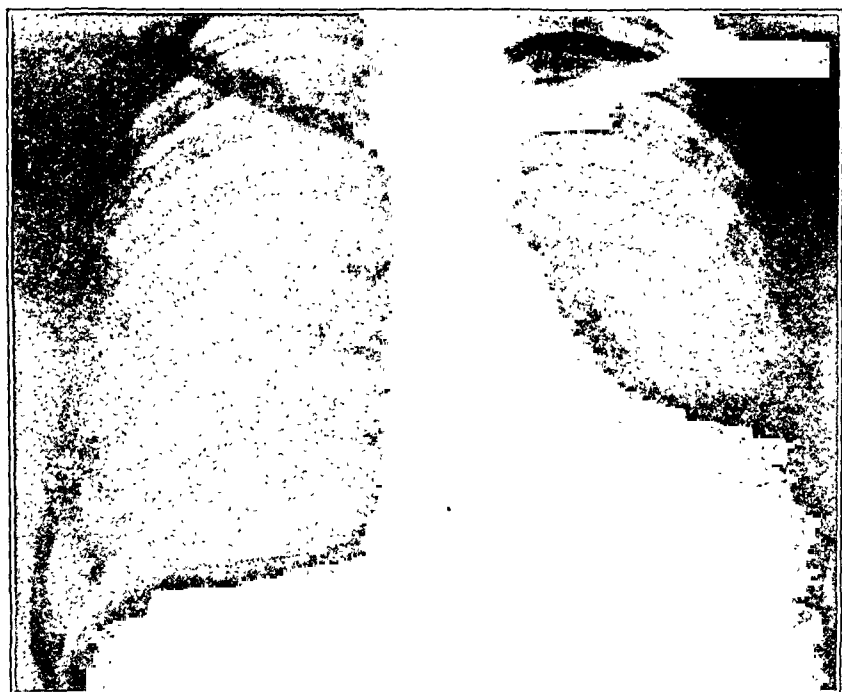


FIG. 4.—Case F. B. Note clear apices. Marked bilateral hilus changes. Dense homogeneous shadows at left lower lobe. Heart pulled to left.

On account of the unilateral lower lobe involvement, clear apices on physical and roentgenological examinations, the negative findings in the sputum, the excellent health in spite of distressing cough and expectoration of long duration and the absence of constitutional symptoms of toxemia, a diagnosis of bronchiectasis, possibly due to thickened pleura, was arrived at.

CASE VIII.—J. L., aged seventeen years, schoolboy, admitted September, 1918.

Family and previous personal history unimportant.

Present Trouble. Began five years ago with moderate cough and expectoration, which greatly increased in severity, so that the cough is now distressing and the sputum profuse, extremely fetid, frequently blood-streaked and brought up in paroxysms of distressing cough, usually early in the morning, influenced by posture. He gained normally in weight, going hand in hand with his growth in

height, and is vigorous and healthy otherwise. He does not remember ever having had constitutional symptoms such as chills, fever, sweats and tachycardia.

On examination we found a very well-nourished young adult, nose markedly bulbous, eyelids puffy, lips, cheeks and nails markedly cyanosed and fingers exquisitely clubbed. Respiratory excursions were markedly diminished throughout the left chest and a dull note on percussion was elicited over both lower lobes, more extensive and marked on the left side. The auscultatory signs suggested the presence of extensive excavation or sacculation over the left lower lobe, and increased whispered voice and many large moist conso-

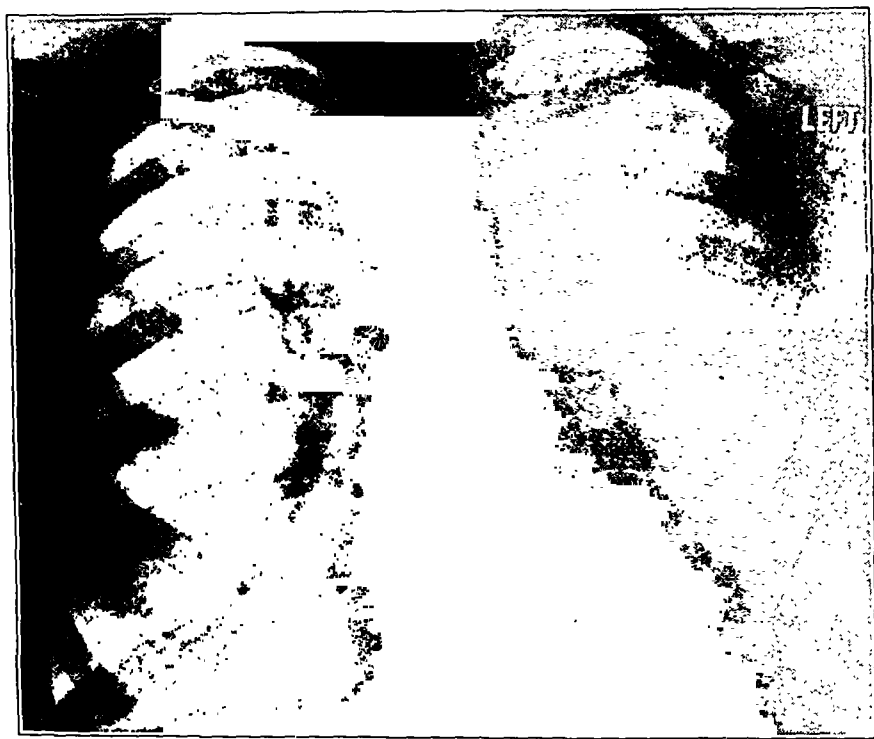


FIG. 5.—Patient J. L. Note clear apices. Considerable density at both roots radiating into the lower lobes; more marked on left side with suggestive evidence of dilated bronchi at the left base.

nating rales were heard over the dull areas. Heart was pulled to the left. Both flat and stereoscopic roentgenograms (Fig. 5) showed clear apices and considerable density of both roots radiating into the lower lobes, more marked on the left side with suggestive evidence of possible dilated bronchi at the left base. Bronchoscopy by Dr. E. Danziger showed a widened left bronchus with pus coming from the lower lobe.

While at the hospital the patient did not have any constitutional symptoms of toxemia. He gained in weight normally; fifty sputum examinations were negative; urine, Wassermann and tuberculosis complement-fixation were all negative. Cough, however, was

distressing and sputum averaged 200 c.c. in twenty-four hours, extremely fetid and frequently blood-streaked.

CASE IX.—M. G., schoolboy, aged eighteen years, admitted March, 1918.

Family and previous personal history irrelevant.

Present Illness.—Began two and a half years ago with cough and expectoration, which gradually increased in severity until six months ago, when the sputum averaged about 400 c.c. in twenty-four hours and was often blood-streaked. Despite the absence of constitutional symptoms of toxemia a diagnosis of tuberculosis was made and he was sent to us for treatment.



FIG. 6.—Patient M. G. Note clear apices. Marked hilus changes radiating into the lower lobes on both sides.

On admission the patient was well nourished, cyanotic, suffused expression, nose bulbous, markedly clubbed fingers. Physical exploration of the chest disclosed dullness over both lower lobes with greatly exaggerated breathing and many large moist rales with increased whispered voice over the dull areas. No pathological changes could be discerned at either apex. There was a soft systolic murmur at the apex of the heart, but it was not transmitted.

While at the hospital the temperature, pulse and respiration remained normal, but cough and expectoration were very distress-

ing, sputum averaging 450 c.c. in twenty-four hours; markedly fetid and brought up in paroxysms of distressing cough. No tubercle bacilli could be found in the sputum on numerous examinations.

The Wassermann and tuberculosis complement-fixation and the urine were negative. Roentgen-ray examination (Fig. 6) revealed clear apices and marked hilus changes radiating into the lower lobes. Bronchoscopy by Dr. E. Danziger showed a widened right bronchus, with pus coming from the lower lobe.

DISCUSSION. Bronchiectasis is very often confused with pulmonary tuberculosis because many of the symptoms, physical signs and, at times, the roentgenograms of the two bear a striking resemblance to each other. It is apparent that a differential diagnosis is urgently called for, since the patient may be detained as a germ carrier by diligent health officers. The prognosis is also more favorable in advanced tuberculosis.

The factors entering into the causation of bronchiectasis have been variously described. As early as 1838, Corrigan insisted that cirrhosis of the lung was the usual cause of bronchiectasis. A few years later Charcot pointed out that bronchiectasis occurs as a sequel of bronchopneumonia, in which there was a destruction of the muscularis and elastic coats of the bronchi.

The consensus of opinion at the present time is that bronchiectasis is due to a combination of causes within the bronchi and causes external to the bronchi. Among the causes of bronchiectasis emanating from within the bronchi, acute and chronic bronchitis, pertussis and foreign bodies are best known. In such cases there exists an inflammatory process in the walls of the bronchi due to local infection which tends to paralyze the underlying muscle tissue. The cartilages of the bronchi do not form perfect rings, *i. e.*, yellow elastic tissue joins the ends of the cartilage to complete the ring, and the amount of cartilage in each ring diminishes as the bronchi subdivide into the branches of smaller caliber.¹ During cough the pressure within the bronchi may rise from normal—2 mm. of Hg. to 100 mm. of Hg. and even higher.² The increased pressure, exerted upon the paralyzed musculature and incomplete cartilaginous rings, tends to dilate the bronchi at their most vulnerable points.

Bronchiectasis is also the characteristic sequel of an obstructed bronchus produced by the impaction of a solid foreign body. The local irritation and subsequent infection thus produced causes an increased secretion beyond the point of obstruction, which can never be completely expelled, and a fermenting residue remains. A septic bronchitis is thus produced and the inflammatory changes

¹ Gray, H.: *Anatomy*, p. 1197, Lea & Febiger, Philadelphia and New York, 1910.

² McPherdan, A.: *Osler's Modern Medicine*, iii, 636, Lea & Febiger, Philadelphia and New York, 1907.

decrease the tonicity of the bronchi. The chronic inflammatory process spreads to the peribronchial tissue and then to the lung, with the inevitable result of pulmonary fibrosis, shrinking of the lung tissue and dilatation of the affected bronchi. The rending effect of the cough in case the obstruction is incomplete further augments the bronchiectasis.

Chronic interstitial pneumonia and thickened pleura of non-tuberculous origin are the extra bronchial causes of bronchiectasis. In chronic interstitial pneumonia, fibrous growth replaces the normal texture of the parenchyma, and more or less collapse of that part of the lung is produced. The connective tissue thus formed, by virtue of its contraction, tends to dilate the nearest bronchi. This mechanism is further augmented by the inspiratory act which permits the atmospheric pressure to dilate the bronchi, traversing the collapsed and non-expanding lung tissue.

It is conceivable that the recession of the chest wall during the act of inspiration is a most potent factor in dilating the already weakened bronchi. It is well known that firm pleuritic adhesions binding the collapsed and fibrosed lung tissue securely to the chest wall are almost invariably found in these cases. The inspiratory recession, therefore, causes the chest wall to pull directly on the walls of the bronchi. When dilatation of the bronchi is once begun the stagnating bronchial excretion by its devitalizing actions markedly decreases the tonicity of the bronchi, and some passive dilatation is also produced. These mechanisms of bronchiectasis similarly hold good in cases of old standing empyemata and greatly thickened pleuræ associated with changes in the vesicular texture of the underlying lung.

In the diagnosis of bronchiectasis the history of the onset is most important. In bronchiectasis resulting from causes other than a foreign body the symptoms appear most insidiously. The patient has usually been coughing and expectorating for many years following a pneumonic process. He gives no history of constitutional symptoms of toxemia such as tachycardia, recurring chills, fever and sweats, nor does he claim to have lost in weight, as is the case in tuberculosis. He does not complain of lassitude in the afternoon hours and leads a moderately active life. Hemoptysis at once considered pathognomonic of tuberculosis, occurs almost as frequently in bronchiectasis. The excessive amount of sputum expectorated is not as important as the manner in which it is brought up. In bronchiectasis it is raised spasmodically in mouthfuls, usually in the early morning hours after a restful night. The expectoration is most markedly influenced by posture. The abundant sputum may be fetid, but not necessarily so, and its separation into three layers is of no diagnostic significance, since sputum of most advanced tuberculous, when abundant, will exhibit the same phenomena. The patient usually presents a suffused

expression, puffy eyelids and bulbous nose in contradistinction to the emaciated, flushed appearance of the tuberculous.

Since bronchiectasis is secondary to a variety of chest conditions the physical findings will frequently be those associated with the condition preceding bronchiectasis. Physical examination may be quite disappointing in the early stages of the disease and signs usually noted are similar to those of chronic bronchitis. It is only later in the disease that clubbed fingers and marked pulmonary osteo-arthritis are noted. This occurs more frequently in bronchiectasis than in any other pulmonary affection, save abscess of the lung. The ordinary cases of bronchiectasis, however, are not seen very early, and when they do present themselves for treatment, the signs most usually elicited are impaired resonance over the affected area, with auscultatory evidence of congestion, sacculatation or cavity formation, most usually unilateral and almost invariably at the lower lobe. The hemothorax affected shrinks in all diameters and the mediastinum is pulled to the side affected just as frequently as in tuberculosis. The upper lobe of the same side may share the pathological changes of the lower lobe,³ but when the disease continues and passes, so to say, to the other side it is again the lower lobe that is first affected.

Pathological changes in pulmonary tuberculosis almost invariably spread from above downward. In bronchiectasis the reverse is true. It is a fact of extreme importance to note that bronchiectasis most usually affects the lower lobe, and is most frequently unilateral. Its occurrence in an upper lobe exclusively has been recorded, but is very rare indeed.

Laboratory findings at times may not be of assistance in the differential diagnosis, except, of course, when tubercle bacilli are found in the sputum. Guinea-pig inoculation with the sputum in question may rule out active tuberculosis.

Roentgenograms, although invaluable in certain cases, may be very misleading at times when the disease has spread so as to affect the upper as well as the lower lobe. When showing clear apices the plate is of extreme diagnostic value in ruling out tuberculosis. Slight shadows at the base, however, which is all we frequently see in typical cases of bronchiectasis, cannot usually be correctly interpreted and very often definite sacculations, found on physical examination and confirmed by anatomical investigation cannot be seen either on flat or stereoroentgenograms.

The tuberculosis fixation test, at first heralded as being of extreme diagnostic importance, has misled us in a few cases, and should therefore not yet influence us in making a definite differential diagnosis.

³ Report of Work of Pathological Department of Brompton Hospital, Tab. VIII, p. 33.

SUMMARY. A diagnosis of bronchiectasis may be arrived at only after a careful history of the case has been taken and painstaking repeated physical examinations have been resorted to. Given a patient with a history of cough and profuse expectoration of many years' duration following pneumonia, yet well nourished, leading a moderately active life, especially when no history of such constitutional symptoms as tachycardia, chills, fever and sweats can be obtained, and the abundant sputum after repeated and careful examinations does not show the presence of tubercle bacilli, it is most probable that the disease in question is not tuberculous in character, although hemoptysis may have been complained of. When this is supplemented by repeated physical explorations of the chest, which show that the lesion is to be found exclusively at either or both lower lobes and the apices are free from disease, a diagnosis of bronchiectasis may be justifiable. Guinea-pig inoculation of the sputum in question may rule out tuberculosis. Roentgenogram and at times bronchoscopy may be of assistance. Tuberculosis complement-fixation is not as yet to be relied on. It must be emphasized that extensive basal tuberculosis is most frequently a terminal condition and is associated with bilateral upper-lobe involvement and marked constitutional symptoms of toxemia.

I wish to express my indebtedness to Dr. Maurice Fishberg and Dr. Alfred Meyer, from whose services the report of the cases was taken, for their valuable suggestions.

A CASE OF ENLARGED THYMUS GLAND AND SOME REMARKS ON STATUS LYMPHATICUS.¹

BY RICHARD COLE NEWTON, M.D.,

CONSULTING PHYSICIAN TO THE MOUNTAINSIDE HOSPITAL, MONTCLAIR, N. J.

W. S., aged twenty years, 5 feet 6 inches tall; weight, 145 pounds. A patient of Dr. William F. Grady, of Montclair, presented the following history and symptoms.

Family History. Negative.

Personal History. Negative.

Present Condition. Patient has always been well. No similar case is known to have occurred in any member of his family, immediate or remote. In the spring of 1917 the patient undertook strenuous farm work near Greenwood Lake, N. J. Once after exhausting labor he jumped into the lake when overheated. He swam a considerable distance. No immediate untoward effects were noticed, but in about two weeks he began to complain of lassitude and loss

¹ Read by title before the American Climatological and Clinical Association at Atlantic City, June 17, 1919.

of muscular vigor, with some dyspnea. (His habits were good. No tobacco, no spirituous liquors, not addicted to venery—seems to have little libido sexualis. Is athletic and fond of outdoor sports.) Being unable to work, he returned to his home in Montclair. By this time his neck, upper chest and shoulders, especially the right, had begun to swell with soft edema. There were also a number of maculæ, dark purple in color and about the circumference of a dime, in clusters over the upper sternal region. These lasted about two weeks. The lower part of the cheeks and the neck looked like those of a person with a large goiter, although the swelling was more evenly distributed than in the average goiter case. The dyspnea, loss of muscular tone, etc., gradually increased. The patient was taken to a prominent consultant in New York City. A loud double heart murmur had developed and the patient seemed very sick. The consultant declined to make a positive diagnosis. There were no symptoms especially referable to the heart beyond those mentioned above. The throat and fauces were normal. No enlargement of the tonsils or increase in adenoid tissue. No fever or chills. Appetite fair, less ravenous than usual (patient has always been a very hearty eater). No glandular enlargements noted. No pain or headache. Urine examined and found normal. No constipation or edema other than that mentioned. No sweats or tremors. Occasional tachycardia. Pulse usually about 60. The consultant thought there might be an aneurysm and advised a roentgen-ray examination. This was made by Dr. Charles F. Baker, of Newark, who found the thymus gland so enlarged that it covered all, or nearly all, of the anterior surface of the pericardium. The patient received six roentgen-ray treatments in all, at weekly intervals, starting with 3x and gradually increasing to about 10. By this time the edema had entirely disappeared. He resumed his previous habits as to various activities, dancing, playing baseball as well as basket and football, swimming, etc. In about a year the edema and dyspnea returned. The roentgen-ray treatment was resumed and the patient after nine exposures is now again free from edema. He is taking 20x and expects to take two more treatments. The patient, although he has carefully concealed the fact from his usual medical attendant, took a sharp run of about a mile to catch the last train two or three months ago. He made the distance in record time, but apparently brought on a recurrence of his former symptoms, and both he and Dr. Baker believe that the imprudence in running (with perhaps a subsequent chill from riding in the cars when overheated and exhausted from the exertion, induced the recurrence of his former symptoms). The heart murmur, although milder than formerly, is still present. The boy's general condition seems good at this writing (September, 1918).

Although there was improvement after the second series of roentgen-ray exposures just alluded to, this was only temporary.

The following extract from the records of Dr. Baker's office throws some light upon the condition, although it cannot be positively asserted that the roentgen-ray diagnosis of a tuberculous infection proves anything regarding the etiology of the thymus overgrowth.

REPORT OF ROENTGEN EXAMINATION OF W. S., JUNE 29, 1918.
"Two stereoscopic plates of the chest were made, which show practically the same condition as the first two taken (some months ago). As regards the thymus, I do not think the thymus shadow is quite as large as it was in the first set of pictures."

"There is a distinct cloudiness of the left lung and the shadows of the bronchi in the apex (first and second interspaces) are clear to the periphery. In the lower portion of the upper right lobe the shadows are very dense, all of which indicates there has been an involvement of this lobe with tuberculosis.

"A comparison of the last set of plates with the former also shows a slight degree of cloudiness and fibrous-tissue deposit, but the former set of plates are not as good in this respect as the latter.

"SUMMARY. The return of the edema of the face seems to indicate there should be more therapeutic roentgen-ray treatments given, and I would suggest a careful physical examination of the chest, temperature, etc., to determine if there be an active lesion of the left side at this time."

The patient gradually lost ground. Dr. Baker asserts that no lasting benefit followed the second series of roentgen-ray exposures, nine in all, although great improvement, which it was hoped would be permanent, had followed the original six exposures. The patient seemed to have been unusually active during the extremely cold weather of the winter of 1917-18, which his attending physician thought was especially injurious to him. In the fall of 1918, after the overexertion in running for the train, previously mentioned, he began to have edema and the adverse symptoms already mentioned, especially a gradual failing of strength. Two Wassermann tests were negative. He developed an aneurysm of the aortic arch, with protrusion of the upper sternal region, and a distinct tracheal tug. Edema of the feet and ankles, hands and wrists developed, and there was excruciating pain in the right arm and shoulder. He gradually became helpless. There was nothing abnormal found in his urine. There was marked orthopnea, so that a Fowler bed had to be used for him. For the last two or three months of life the patient had to be kept under constantly repeated doses of morphin. There was no edema of the face and no maculæ present, as in the earlier part of his illness.

He died March 31, 1919, from rupture of the aortic aneurysm. An autopsy could not be obtained.

A case as rare as this accentuated with such marked symptoms seems to the writer worthy of careful study.

At the risk of being wearisome it seems necessary to give somewhat in detail a résumé of the better known observations on the nature and functions of the thymus gland:

The weight of the gland at birth is given by various writers at from 13.75 grams all the way down to one-third or less of that figure. Howland,¹ from an examination of the glands of 495 patients under five years of age, found the average weight to be from 4 to 6 grams.

Mayo and McGrath² make the very practical observation that inasmuch as the size of the normal gland varies within such wide limits, it is probable that with more exact knowledge "we shall be able to estimate the physiological value of the organ, not so much by its gross size or weight as by a scientific determination of its normal, subnormal or supranormal parenchymatous value." In this connection also we must not lose sight of the possibility of accidental involution from various causes.

Exactly what the thymus is meant to accomplish in the economy is largely a matter of conjecture. Sajous¹⁹ has satisfied himself and some others that that gland is put in the body to manufacture the phosphorus needed in osseous formation. Another explanation of the function of the gland is that it controls or regulates the deposit of lime in the bones. These are examples of the statements of the bolder spirits who are willing to risk their reputations in ascribing particular attributes to this baffling little organ.

In 1614 Felix Plater³ reported the first known case of alleged death from an enlarged thymus in an infant, and in 1659 Wharton⁴ observed accidental thymus involution in animals after excessive exertion. In the case I am reporting, if excessive exertion had any causative effect on the status of the gland, it was probably that of evolution. After Wharton's discovery it was noted that chronic diseases and starvation quickly reduce not only the weight but the parenchymatous value of the thymus. And Rudberg⁵ has noted the regeneration of the thymic elements after the gland had been exposed to the roentgen-rays. Friendleben⁶ has stated that complete regeneration of the thymus can occur, as shown by animals overfed after nearly complete starvation.

MINUTE ANATOMY. The gland contains two types of cells, the reticular and the so-called thymic lymphocytes. The former are considered epithelial elements, which result from a direct transformation of the primary thymic anlage, and during the entire existence of the organ maintain their epithelial character. The corpuscles of Hassall, which are small concentrically striated bodies peculiar to the thymus, are to be considered as modified epithelial reticulum cells. The lymphocytes in the thymus have called forth much discussion into which we have no time to enter. Clinically they are of special interest by reason of their susceptibility to change. It is these cells that are melted away, as it were, by the roentgen-rays and presumably it is the regeneration or recreation of these

cells which causes a regrowth of the thymus body. Eosinophiles have been found in the thymus of very young children. It is denied that these cells exist in the adult thymus in men or animals. Pappenheimer⁷ believes that the presence of these cells designates a definite stage of secretory activity similar to that observed in the hypophysis and parathyroids. Rudberg⁵ observed that after exposure to the roentgen-rays there was an invasion of pseudo-eosinophilic cells synchronously with the destruction of the small cells of the thymus.

GROWTH AND INVOLUTION. Here again many theories are advanced. Mayo and McGrath¹ say that lack of knowledge as to the importance of the thymus in later life is a source of confusion in the diagnosis of various altered conditions of the body. There are remnants of thymic tissue present in man even in old age. Just what their import may be is very doubtful. The older pathologists and anatomists regarded them as merely vestigial, as indeed they regarded the hypophysis and the pineal gland. Of course, I do not refer to the mythological age of medicine when the last-named gland was considered the residence of the human soul. It has also been stated that the thymus was "persistent" or hyperplastic in association with certain diseased conditions. McAuliff¹⁶ says: "The thymus like the thyroid does not seem to be so intimately connected with sexual characteristics, but does have some association as it is persistent in eunuchs. Possibly like the pineal it has a limited function in the growing body previous to puberty. This is an aspect of the subject that demands further study. Even the normal involution of the average thymus is still undetermined. Some authors maintain that the principal growth in weight and function takes place between the first six months and the third year of life while others assert that not until the tenth or fifteenth year is the highest point reached. Most investigators believe that thymic growth takes place in post-fetal life, but when this growth reaches its acme and how long the gland is physiologically active is still uncertain. Hart⁸ says in the case of physiological involution there is a genuine growth of fat tissue, which can yield at any time to a new formation of parenchymatous islands, while in the pathological involution of the gland there is reactive connective-tissue growth and sclerosing which in all severe cases leave irreparable changes in the organ. Some observers, however, believe that the involution of the gland is due to a simple cirrhosis. The epithelial portion of the organ naturally proves the more resistant and is said to assume the active role of cirrhosis. Rudberg⁵ has called attention to the regeneration of the thymic elements after exposure to the roentgen-rays.

PHYSIOLOGY. Here again the mountain has labored with rather insignificant results. Still, certain valuable conclusions have been reached. It has been asserted that, as an accelerator of the pulse and a depressor of the blood-pressure, the thymic extract (also the thyroid extract) acts antagonistically to the extract of the chromaffin

system and that an injection of the expressed juice of the thymus into animals may result fatally after causing a fall in blood-pressure and the pulse-rate. The thymus was removed from puppies on the tenth day of life with no apparent immediate results. There was growth and weight increase in both the puppies which had been treated and the controls, but the increase in the former was fatty instead of muscular. Their bones were soft; they were weak and listless. There was a decrease in intelligence. They ate what was set before them without discrimination. After three or four months they fell behind the controls in growth. Their bones grew softer, they suffered from spontaneous fractures and frequent convulsions and became finally completely idiotic, and after six to fourteen months died in coma. At autopsy their brains were swollen and edematous, bones undersized, soft and pliable, with thick epiphyseal cartilages. Microscopically there was osteoporosis and cartilaginous overgrowth. Chemically the bones showed 32.34 per cent. of calcium while those of the controls showed 65 per cent. Similar results were noted in another experiment on puppies except there was less mental hebetude present. The picture of thymoprivia was typical and similar to advanced rickets, and due, as Matti⁹ claims, to the impaired capacity of the excessive new bony tissue to assimilate calcium. No correlation between the status of the blood and the thymic changes was observed in extra-uterine life. The physiological decrease of the lymphocytes and the increase of the neutrophilic leukocytes occurred later than in the controls. After thymectomy there occurs a microscopic and macroscopic hypertrophy of the intrasuprarenal part of the chromaffin system, with indications that the process is correlative with the loss of the thymus. The thyroid showed slight increase in weight. There seemed to be a reciprocal relation between the thymus and the spleen. The hypophysis appeared to be relatively larger, although it was small in the stage of cachexia. The liver and pancreas were apparently enlarged. These experiments seem to show conclusively that the thymus is not a superfluous organ in growing dogs. In some cases compensatory activity of the related organs and the accessory thymic lobes may prevent the occurrence of symptoms after thymectomy. It seems to be established that the thymus, thyroid and parathyroids are closely related in function. Bourneville¹⁰ noted the absence of the thymus in 25 out of 28 mentally defective children. Other experiments on dogs show that thymectomies to adult animals are without obvious effects and the assumption that the thymus and the chromaffin system are antagonistic in function seems at least plausible. The former inhibits and the latter excites the sympathetic nervous system.

Popper¹¹ assumes that the thymic extract influences clot-formation and should be taken into account in considering vascular thrombosis

as a possible cause of cardiac weakness and sudden death in cases of hyperthymization, whether occurring in men or animals.

Wiesel¹² remarks that the contention that the signs of hyperthymization are rather due to resorption than to specific intoxication should be received with great consideration.

PATHOLOGY. Many causes for pathological thymic conditions have been noted, the gland may be congenitally absent, certain of the changes observed in it may have been postmortal, while the infectious diseases of children, overexertion and starvation, as already noted, may obliterate it, as well as circulatory diseases, acute inflammations, syphilis, tuberculosis and neoplasms. Frequently after death the parenchyma may be found hollowed out, which is alleged to be due to autolysis caused by the proteolytic thymic ferment, as demonstrated by Kutscher.¹³ It is held that a strictly normal thymus is rare in the human body. Many of the older autopsies were inconclusive, owing to lack of proper microscopic confirmation of the gross anatomy. Hemorrhages in the thymic body are not rare. A man who died suddenly three weeks after castration had a clot in the thymus. Small hemorrhages have been found in the gland of the newborn, due probably to difficult labor. The infections, phosphorus poisoning, hemophilia and so on have been given as the cause of thymic hemorrhage. Three or 4 per cent. of 350 autopsies showed syphilitic infection of the thymus. It is claimed that syphilitic infection of the thymus may be the sole manifestation of the disease. Primary tuberculosis of the gland does occur, but this lesion is usually secondary to tuberculosis of the bronchial glands, general miliary tuberculosis or caseous pneumonia. Tubercle bacilli have been found in the thymic tissues. The condition is not generally recognized during life. New growths of various sorts have been found in the thymus. Cysts of the gland have been found in normal as well as in pathological conditions.

STATUS LYMPHATICUS. Richardson²⁰ says that in most cases when there is marasmus or a condition of malnutrition the thymus gland is quite small. Conversely most of the status lymphaticus cases are fairly well nourished.

Of the large number of infants dying suddenly, sometimes with and sometimes without one or more preliminary suffocative attacks, many at least must have succumbed to pressure, especially upon the trachea, which has been found flattened at different levels. There has also been pressure upon the innominate vessels where these cross the trachea. The bronchi have also been found flattened and atrophy of the cartilaginous tracheal rings from pressure has been noted. Extension of the head and neck naturally tends to increase the dyspnea. Mayo¹ reports two successful operations for relief of thymic pressure. In one case he only removed the right lobe, in the other, one-half of this lobe, which weighed 10 grams. Death

from thymic pressure is strenuously denied by some; one observer asserts that in 2341 postmortem examinations of children, 83.1 per cent. of whom were nurslings under one year of age, not one death could be fairly attributed to thymic pressure. Dysphagia from pressure on the esophagus has been noted. While the cause of so-called thymic death, not to mention asthma, tetany, laryngismus, stridulus and other suffocative manifestations formerly attributed to thymic enlargement, has not been definitely settled, it would appear that those who deny the causative connection of pressure *in toto* are taking too strong ground. Mayo and McGrath¹ say that the gland can act in a mechanical way in causing severe disturbance, while they admit that sudden death solely from enlargement of the thymus is extremely rare, and, of course, the condition that is presumed to have caused the thymic hyperplasia has no doubt predisposed the affected person to sudden cardiac or suffocative dissolution. Yet considering the favorable results of the few cases of thymectomy in children reported (and there seem to be less than a dozen of them) it must be admitted there is a good deal to be said in favor of the operation and the relief of pressure. When the Mayos can point to 1000 or 2000 thymectomies done in their own clinic, as they did some years ago to 5000 thyroidectomies done in that famous clinic, they will no doubt be able to give us something quite definite regarding the thymus, its functions and its diseases. What seems necessary at the present writing is more bedside and operative work. Nor is this the only hitherto unsolved problem in medicine that cannot be brought to a clear and demonstrable solution without a closer conjunction of the efforts of clinical, laboratory and pathological workers. Now, alas! working usually quite independently and sometimes, at least, unable to judge of their own limitations.

In many sudden deaths, where there was no apparent cause, and also in some seriously diseased conditions, an enlarged, persistent thymus has been observed, either alone or coexisting with certain abnormal conditions in the lymphatic system and other bodily organs. These changes, as a whole, were originally grouped together under the title of status lymphaticus; but recent observers have subdivided this syndrome into three subdivisions as follows: status thymicus, status thymicolymphaticus and status lymphaticus. These three conditions are so named according to the size and the apparent activity of the thymus. The status thymicus has already been briefly discussed. In it the size of the thymus is usually larger than in status thymicolymphaticus and is not accompanied by marked changes in the lymphatic system. In the status thymicolymphaticus there is a general hyperplasia of the lymphatic tissues throughout the body, especially the tonsils and the lingual, pharyngeal and cervical glands. While in the status lymphaticus the thymus is not enlarged and may even be subnormal in size, nevertheless

the size of this organ is probably not of itself a criterion of the systemic lesions present in these three allied conditions.

Most of the cases of so-called thymic death occurred in adults; but some have happened in infancy and early life, and probably some of them were not attributed to the right cause. Among the conditions under which these sudden deaths have occurred were bathing, general and local anesthesia, operations (often trivial), flogging, coitus, mental excitement, ordinary walking and even rest.

Among the diseases having a more or less close relation to the thymic and general bodily conditions under discussion are exophthalmic goiter, Addison's disease, diphtheria, tetanus, eclampsia, eczema in children, myasthenia, osteomalacia, burns, etc. Bartels²¹ reports that in 122 cases of suicide 36 per cent. were cases of status thymicolymphaticus, 26 per cent. were cases of lymphaticus and in 20 per cent. there were some signs of lymphatism. Diphtheria is one of the diseases often associated with lymphatism. Most cases of tetanus and a number of cases of eclampsia in females are associated with status thymicolymphaticus. Uhlenhuth¹⁷ says the relation of the thymus to tetany may possibly explain the occurrence of tetany during pregnancy; while the parathyroids of the mother may be sufficient to prevent tetany from her atrophied thymus, they may not be sufficient to prevent tetany from the excess of thymus substance furnished by the fetus to the blood of the mother. Thymicolymphaticus, as intimated above, is marked by more or less general involvement of the lymphatic system and also with hypoplasia of the vascular system and the adrenals. Virchow¹⁴ had already described the hypoplasia of the vascular system in 1872 as the "chlorotic constitution." Hyperplasia of the lymphatic system, on the other hand, may be due to infection and improper hygiene. As Kolisko¹⁵ has remarked, the entire lymphatic system can become hyperplastic in consequence of rachitis. Richard Bright first sketched out status lymphaticus in 1838. Oldmacher¹⁸ states that status lymphaticus is divided into the rachitic and non-rachitic types, and notes especially the epiphyseal changes in the bones in the first-named division. Many of the symptoms of so-called lymphatism, as laid down in the literature, seem to merge into each other, and their apparent divergences may in many cases be due to chronological or accidental changes in the same disease. This we might reasonably expect in so changeable an organ as the thymus, both in health and disease. Galatti directs attention to the peculiar tendency to edema in status lymphaticus. There may be, he says, edema of the brain, as noted in the thymectomized puppies already mentioned, as well as eczema and pasty complexion in man. The external edema in our case was, of course, the most prominent symptom. Oldmacher, in this connection, calls attention to edema of the lungs, which he has observed in lymphatic epileptics, dying abruptly in a single seizure or sinking into status epilepticus; and claims that

slight factors like moderate auto-intoxication may activate this tendency in lymphatism. He adds that should cerebral edema cause pressure on the floor of the fourth ventricle sudden death would supervene. He is prone to attribute lymphatism, generally speaking, to some slow-acting systemic poison. Mayo lays down the proposition that the thyroid is an organ of defence and that more or less aid in this function is received from the normal thymus. And it would appear to be firmly established that in early life, at all events, a normally acting thymus is essential to proper development. It will be observed that Mayo¹ only removed part of the overgrown thymus, just as only part of the enlarged thyroid is removed by operation. Why ablation of part of an improperly functioning gland should obviate its overaction is difficult to explain unless it may be due to removal of a large part of its secretory elements, and whether this operation does correct temporarily or permanently the vascular hypoplasia, the changes in the chromaffin system and so forth found in lymphatism has, so far as I know, not yet been definitely ascertained.

We should notice, before closing, that Gowers urged prophylaxis against rickets as a preventive measure against epilepsy, and Oldmacher takes similar ground regarding tetany, spasm of the glottis and eclampsia; conditions accompanying, if not always due to lymphatism; while Mendel attributes rickets to disturbance of the internal secretion of the thymus gland. Hence, while this study of ours has not been as conclusive as we could wish, it tends to emphasize the fundamental importance of laying the foundation for normal, mental and bodily development by insisting on the inalienable right of every infant to be nourished at the breast of a healthy woman.

What other practical conclusions may we draw from the foregoing? The roentgen-ray has removed some at least of the uncertainties of the diagnosis and has seemingly favorably influenced the treatment. The fear that operation will be almost inevitably fatal has been largely removed by the few successful cases reported. These were all in infants so far as I can learn. Whether adults with enlarged thymus should be submitted to the risks of operation has not apparently been determined. However, as said above, of the alleged cases of thymic death the large proportion are adults.

There should be a more strenuous effort made to ascertain whether something definite cannot be done to benefit these cases, as a whole, by hygiene and diet rather than by medication.

It is quite likely that anomalies in the structure and size of the thymus are due rather to a constitutional condition than to primary disease of the organ itself. And these conditions may be brought about by a number of causative factors. Ewing²² emphasizes the fact that there are the stages of hyperplasia and hypoplasia of the thymus and the lymphatic system. These properly carried out

seem to be normal in the human body. Interference with or undue activation of these processes appears to cause the condition which is known as status lymphaticus, which appears to leave, generally speaking, some permanent defects like thin arterial walls, small heart and an excess of lymphoid tissue and may or may not be characterized by the *typus feminis* in males in the conformation of the body. Our patient did not evince these outward physical characteristics, but he had the tendency to edema and to aneurysm so well marked in many of these cases.

It is fair to suppose that in time the greatly enlarged thymus in this case would have atrophied, and had the aneurysm not occurred as a complication, he might have enjoyed a number of years of useful life. The aneurysm itself was quite probably caused by overexertion, perhaps by the strenuous run already mentioned in a person with congenitally weak and attenuated arterial walls.

That the roentgen-rays were so efficient at first and so ineffective afterward was, it may be assumed, because at the first treatment the aneurysm had not developed but that at the second it had become a controlling factor in the morbid conditions.

My thanks are due to Drs. Baker and Grady for material help in preparing this paper.

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TRANSITIONAL LEUKOCYTOSIS AND ITS DIAGNOSTIC VALUE IN CHRONIC APPENDICITIS.¹

By G. A. FRIEDMAN, M.D.,

CLINICAL PROFESSOR OF MEDICINE, NEW YORK POLYCLINIC MEDICAL SCHOOL AND HOSPITAL; VISITING PHYSICIAN, BETH DAVID HOSPITAL; ATTENDING PHYSICIAN IN DIGESTIVE DISEASES, VANDERBILT CLINIC; GASTRO-ENTEROLOGIST, GOUVERNEUR HOSPITAL, NEW YORK.

It is needless to emphasize the fact that there are occasions when it is difficult to correctly diagnose chronic appendicitis. In some instances after the most earnest attempts to establish this diagnosis the clinician seeks an exploratory laparotomy, and, occasionally, the surgeon, too, is unable, even on inspection, to decide whether the removed appendix is diseased or not, and, consequently, consults the pathologist.

Clinically, the tenderness elicited both by pressure on McBurney's and Morris's points and by the methods of Meltzer and Bastedo is well known to the internist and is frequently of great aid in the diagnosis of acute appendicitis. This is not, however, of great value in chronic cases, and, furthermore, does not always indicate true appendicular disease. It may mean, often, for instance, peri-appendicular adhesions. Moreover, roentgen examination of the appendicular region is not sufficiently conclusive. One must agree with Carman² and Case³ that although stagnation of the contrast meal in the appendix, or a visualized appendix in roentgenograms, does not necessarily mean a pathological appendix, yet an appendix may be markedly diseased without being visible in the roentgenograms. Other roentgen signs of appendicitis, such as pressure-points in the ileocecal region or elicited under the fluoroscope, spastic colon, intestinal stasis and even shadows of concretions in the appendix, do not always indicate appendicitis.

A hyperleukocytosis or a polynuclear leukocytosis, or both, when present, are valuable diagnostic aids in acute appendicitis as their presence frequently points to a really more or less acutely diseased appendix. However, such findings are too often absent in chronic appendicitis. Occasionally, however, a leukopenia may be found both in acute and chronic appendicitis.

The routine examination of blood of the so-called dyspeptics, many of whom were actually suffering from chronic appendicitis, suggests that in the differential count there is an important aid in the diagnosis of chronic appendicitis provided an enumeration of the

¹ Read before the American Gastro-Enterological Association, Atlantic City, N. J., June 10, 1919.

² The Roentgen Diagnosis of the Alimentary Canal, W. B. Saunders Company, Philadelphia and London, 1917, p. 513.

³ Roentgen Examination of the Appendix, New York Med. Jour., 1914, No. 4 p. 167.

large mononuclears and the transitional leukocytes is made. There is a definite increase in the number of these cells in the blood of those suffering from chronic appendicitis, although this increase may be slight at times. It may be justly designated as a transitional leukocytosis. Although not an invariable finding it has its definite value. It is found in chronic appendicitis more frequently than a hyperleukocytosis or a polynuclear leukocytosis, and more often than the positive roentgen signs. It may be actually observed and clinically demonstrated that a transitional leukocytosis points to appendicular disease. A transitional leukocytosis is absent in peptic ulcer, cholecystitis, renal colic, etc. (see Tables IV and V). If present in these or in other abdominal conditions there is a chronic appendicitis complicating the existing condition.

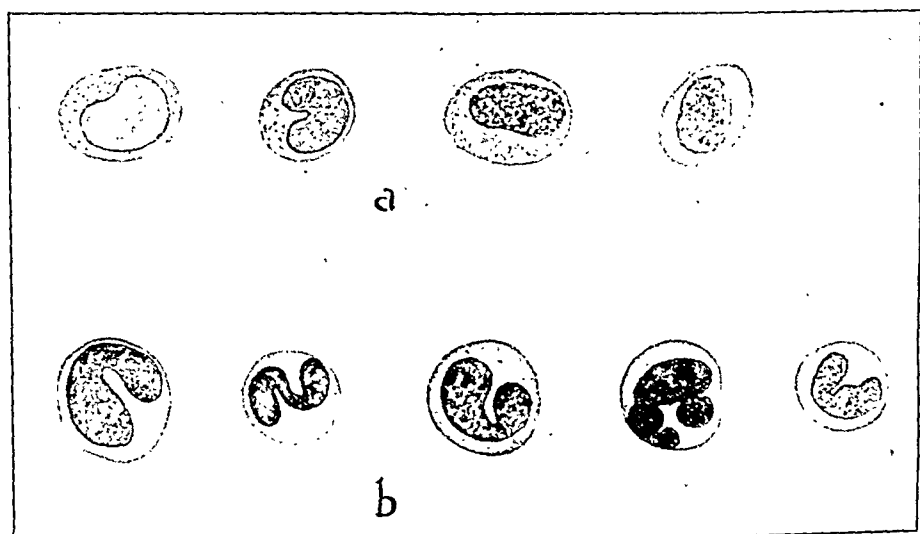


FIG. 1.—Showing the types of cells enumerated as large mononuclears and transitional leukocytes.

The transitional leukocytes differ from the large mononuclears in that the nucleus of the transitional forms assume a horseshoe shape. Hematologists disagree as to the proper grouping of the transitionals when enumerating them in the differential count. Wood,⁴ for instance, believes that the transitional leukocytes should be classed with the neutrophils and should not be considered as a separate group. Naegeli,⁵ on the other hand, states that the transitionals and the large mononuclears belong to the same group and should be thus enumerated. Naegeli's claim is substantiated by the fact that there is no difference either in the protoplasm of

⁴ Chemical and Microscopic Diagnosis, D. Appleton and Co., New York and London, 1911, p. 103.

⁵ Blutkrankheiten und Blutdiagnostik, Verlag von Veit und Co., Leipzig, 1912, p. 180.

the transitionals and the large mononuclears or in the structure of the nuclei, save for their form and curving (Fig. 1). Pappenheim,⁶ however, was the first to demonstrate that a transition from mononuclears to neutrophiles never occurs, and, therefore, mononuclears must be considered as a special ripe form. The percentage of transitionals in normal blood, according to Wood, varies from 2 to 4 per cent. while the percentage of large mononuclears is 1 per cent. These percentages seem to be quite constant. The total number of transitionals and large mononuclears in 100 white blood cells may therefore be considered as 5. The absolute number of large mononuclears and transitionals in a normal white cell count of 10,000 per c.c. will be 400 transitionals and 100 large mononuclears. In other words the transitional formula, sometimes called relative transitional formula, will be 5 and the absolute transitional formula 500. The terms relative formula and absolute formula will be used to indicate the relative and absolute increase of leukocytes belonging to the transitional group. In chronic appendicitis the relative formula, although frequently high, does not necessarily run, for obvious reasons, parallel with the relative formula. Rieux⁶ found a marked increase in large mononuclears (absolute numbers in the blood from 1300 to 1900) in severe perityphlitis. But he, like Naegeli, grouped the transitional forms with the mononuclears. I was not aware, however, of Rieux's findings when in a previous communication⁷ I first emphasized the importance of an increase of large mononuclears and transitionals as a diagnostic aid in chronic appendicitis. The blood in all instances was collected for examination before breakfast or six hours after a meal, in order to exclude a digestive leukocytosis, and not less than 200 cells were enumerated. All were stained by the Jenner method. A white-cell count above 10,000 per c.c. is considered a hyperleukocytosis and in the differential anything above 75 per cent. a polynuclear leukocytosis. A count below 500 white cells to the cubic centimeter indicates a leukopenia. In nearly all cases the blood of adults was examined.⁸

An adequate explanation cannot be given at present for the extreme frequency of a transitional leukocytosis in chronic appendicitis. According to all hematologists large mononuclears are produced in the bone-marrow and as transition forms belong to the same group, they, too, possibly, have the same origin. It may be suggested, however, that the transitional leukocytosis in chronic appendicitis is due to a constitutional disturbance which may possibly also predispose to appendicitis. This idea is strength-

⁶ Quoted by Naegeli, p. 180.

⁷ Friedman, G. A.: The Difference in the Morphology of Blood in Gastric Ulcer, Duodenal Ulcer and in Chronic Appendicitis, AM. JOUR. MED. SC., 1914, No. 4, cxlii, 540.

⁸ To shorten tables, the complete counts have purposely been omitted as small lymphocytes, large lymphocytes, eosinophiles and basophiles have no direct bearing.

ened by the facts that a hyperleukocytosis when present before operation disappears after removal of the appendix and a transitional leukocytosis often does not disappear for months and even years after the appendectomy. This persistence of a transitional leukocytosis recalls the erythrocytosis described⁹ as often occurring in chronic non-bleeding duodenal ulcer, and which also probably is due to a constitutional disturbance, likewise persists after the various surgical procedures.

The present study is based upon 65 cases; 14 of these presented themselves for examination for ailments other than appendicitis, their appendices having been removed previously at the advice of other physicians (see Table VI). For the operative findings I am indebted to the following surgeons: Dr. John A. Bodine, 29 cases; Dr. A. O. Wilensky, 11 cases; Dr. Leo Buerger, 10 cases; Dr. A. A. Berg, 7 cases; Dr. Charles N. Dowd, 2 cases; Dr. Charles Peck, 2 cases; Dr. M. S. Kakels, 1 case; Dr. James L. Russell, 1 case; Dr. Charles R. Hancock, 1 case; and Dr. John B. Deaver, 1 case. For the pathological reports of 10 cases I am indebted to Dr. C. H. Bailey and for the drawings to Mr. Alfred Feinberg.

TABLE I.—APPENDICITIS: WHITE BLOOD AND OPERATIVE FINDINGS.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Absolute transitional formula.	Operative findings.
1	9,200	35.5	2.0	5.0	7.0	644	Constricted and adhesions.
2	16,800	75.5	6.0	9.0	15.0	2520	Chronic and adhesions.
3	4,600	67.0	3.5	3.5	7.0	322	Constricted and adhesions.
4	7,800	65.0	5.5	5.5	11.0	858	Gangrenous.
5	24,000	77.5	6.0	4.0	10.0	2400	Fibrinous.
6	8,400	55.0	2.5	11.0	13.5	1134	Chronic.
7	6,000	57.0	1.0	6.0	7.0	420	Chronic.
8	8,000	72.0	1.0	6.0	7.0	560	Chronic.
9	8,000	62.0	3.0	7.0	10.0	800	Chronic and adhesions.
10	11,300	68.0	0.5	2.5	3.0	339	Chronic.
11	11,000	42.0	6.0	0.0	6.0	660	Chronic and adhesions.
12	12,600	79.0	7.0	3.0	10.0	1260	Retrocecal and adhesions.

In Table I the relative formula is found to be in the majority of cases above 5 and the absolute formula above 500. In these patients the appendicular region alone was explored at operation, since the symptoms and signs did not point to any other organic disease within the abdomen. Roentgen examinations were not made. In all but one the high relative formula proved to be of definite diagnostic value.

⁹ Friedman, G. A.: Weitere Erfahrungen über Polyzythemie beim chronischem uncomplicierten Duodenalgeschwuer, Arch. f. Verdauungskrankheiten, Band xix, Ergaenzungsheft, 1913.

Of the 20 cases listed in Table II, in but one (Case 13) the appendix was found to be normal on gross and microscopic examination, even though a high relative formula was found. It is also observed that out of the 19 patients in whom a diseased appendix was found roentgen signs were positive in 13. A hyperleukocytosis was noted in 5 patients, polynuclear leukocytosis in none, leukopenia in 1; of the remainder the number of white blood corpuscles per cubic centimeter of blood was normal. The relative formula was above 5 in 17 patients and the absolute formula above 500 in 14.

TABLE II.—APPENDICITIS: WHITE CELL COUNT, ROENTGEN AND OPERATIVE FINDINGS.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Absolute transitional formula.	Roentgen findings.	Operative findings.
1	11,800	54.0	2.0	4.5	6.5	767	Stagnation of barium in terminal ileum	Chronic and adhesions.
2	10,000	65.0	6.0	5.5	11.5	1150	No signs	Fibrinous.
3	7,200	59.0	2.0	5.0	7.0	504	Spasticity of the colon	Constricted.
4	14,800	75.0	3.0	4.0	7.0	1036	Tender point in ileocecal region	Chronic and adhesions.
5	7,400	68.0	1.5	12.0	13.5	999	Intestinal stasis; visible appendix	Long appendix; mucosa ulcerated.
6	9,600	49.0	1.0	7.0	8.0	768	Visible appendix	Chronic and numerous adhesions.
7	11,200	63.0	4.0	2.0	6.0	672	No signs	Chronic obliterative and adhesions.
8	6,600	72.5	2.0	5.0	7.0	462	Spasticity of the colon	Chronic.
9	4,200	51.0	6.0	13.5	19.5	819	No signs	Perforated.
10	6,400	57.0	0.5	7.5	8.0	512	No signs	Fibrinous.
11	8,600	58.0	0.5	0.0	0.5	43	Tender point in ileocecal region; visible appendix	Kinked and adhesions.
12	6,400	42.0	3.0	9.0	12.0	768	No signs	Chronic.
13	5,400	57.0	4.0	4.0	8.0	432	No signs	Normal and adhesions.
14	11,600	62.5	4.0	5.5	9.5	1102	Visible appendix	Constricted.
15	6,800	45.0	6.0	9.0	15.0	1020	Visible appendix	Chronic.
16	10,400	42.5	1.5	4.0	5.5	572	Visible appendix	Kinked and adhesions.
17	7,200	37.0	0.5	0.0	0.5	36	Adhesions about appendix	Retrocecal and adhesions.
18	6,000	61.0	1.5	1.5	3.0	180	Intestinal stasis	Chronic.
19	9,900	62.0	1.0	6.0	7.0	693	No signs	Constricted and adhesions.
20	5,000	51.0	3.5	5.0	8.5	425	Visible appendix	Chronic and concretions.

In all the cases tabulated in Table III roentgen examinations were also made to help establish the diagnosis of appendicitis, and if these findings and the roentgen results of Table II are compared with the transitional group counts in both tables, it is noted that roentgen signs were positive in about 57 per cent. of the cases; transitional leukocytosis in about 87 per cent. of them.

It may be added that the transitional formula was computed in many conditions. It was found to be low in achylia gastrica, in gastrosuccorrrhea, in gastric catarrh, in gastric crises of tabetics, in pernicious anemia, in 2 cases of myelogenous, in 1 case of myxedema, in 6 cases of hyperthyroidism and 3 cases of Addison's disease. A high transitional formula was occasionally found in gastric

and intestinal cancer, and in 1 case of achylia gastrica in which tenderness was elicited by the Meltzer method and marked tenderness in the appendicular region was also found on fluoroscopic examination.

TABLE III.—WHITE CELL COUNT IN APPENDICITIS, ASSOCIATED WITH OTHER CONDITIONS: ROENTGEN AND OPERATIVE FINDINGS.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Absolute transitional formula.	Roentgen findings.	Operative findings.
1	6200	62	1.5	4.5	6.0	372	Adhesions about appendix	Appendix chronic and adhesions; strawberry gall-bladder and pericholecystic adhesions.
2	4400	66	0.0	2.0	2.0	88	Tender point in ileocecal region; visible appendix	Appendix buried in adhesions. Chronic cholecystitis with adhesions.
3	5200	60	4.0	7.0	11.0	572	No signs	Appendix linked with concretions—numerous adhesions around; callous ulcer at pylorus posteriorly; thick gall-bladder with several stones.
4	4800	41	4.0	6.0	10.0	480	Tender point in ileocecal region	Appendix; chronic indurated ulcer at lesser curvature, near pylorus; adhesions between gall-bladder and pylorus.
5	6900	70	4.5	3.5	8.0	552	No signs	Appendix; mucosa inflamed and ulcerated; broad adhesions band; callous ulcer at first portion of duodenum, anteriorly.
6	7100	61	3.0	5.0	8.0	568	No signs	Appendix constricted with adhesions; callous ulcer at the first portion of duodenum anteriorly.
7	8000	50	7.0	5.0	12.0	960	No signs	Appendix adherent with inflamed mucosa; callous ulcer at first portion of duodenum with small perforation.
8	3800	59	5.0	1.0	6.0	228	No signs	Appendix constricted and adhesions; callous ulcer at first portion of duodenum anteriorly.
9	7400	50	1.0	6.0	7.0	518	Tender point in ileocecal region	Appendix chronic; broad band around colon causing intestinal obstruction; diverticulum in the colon.
10	5400	56	1.0	1.0	2.0	108	No signs	Appendix chronic; ulcer between second and third portion of duodenum.
11	9400	52	1.5	6.5	8.0	752	No signs	Appendix kinked, thickened and bound by adhesions; scar at extreme portion of pylorus.
12	4600	66	0.0	2.5	2.5	115	No signs	Long appendix; no inflammation; adhesions at mesentery and between gall-bladder and pylorus.
13	7400	44	4.0	4.0	8.0	592	Tender point in ileocecal region and intestinal stasis	Appendix chronic and adhesions; perforated duodenal ulcer.

ABSTRACTS OF HISTORIES OF ILLUSTRATIVE CASES.

CASE I (Case 15, Table II).—H. G., female, aged fifteen years; first seen April 6, 1918. Complained of obstinate constipation. Two weeks previously she had an attack of pain in the right lower quadrant of the abdomen. Physical examination revealed marked

tenderness in the appendicular region, which was also elicited by Meltzer's method. The appendix was visible six hours after ingestion of the contrast meal and remained visible in the twenty-



FIG. 2.—Showing barium-filled appendix twenty-four hours after ingestion of the barium meal.

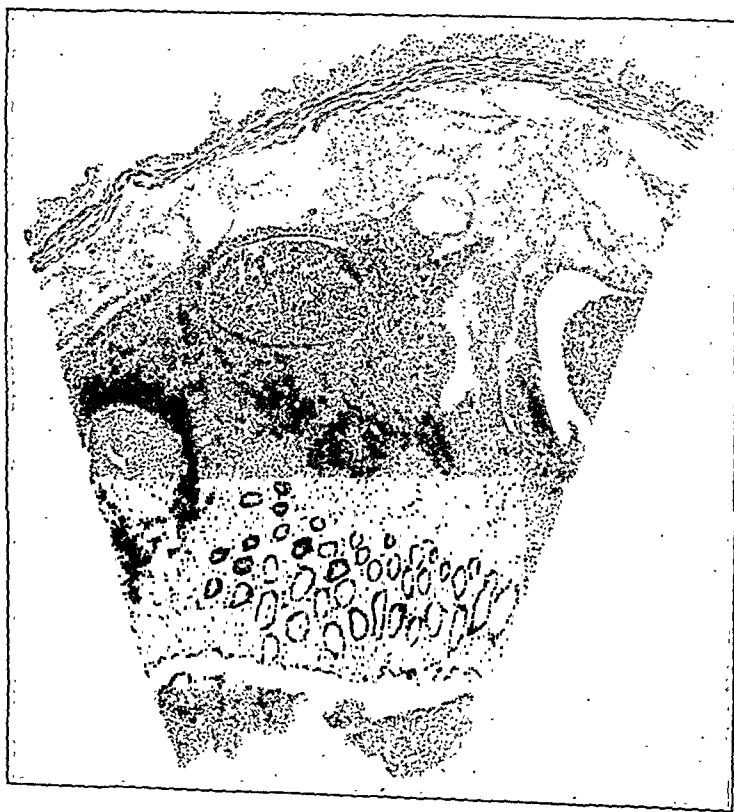


FIG. 3.—Section from the wall of the appendix showing both a moderate infiltration with eosinophile polymorphonuclear leukocytes and edema of the mucosa and submucosa.

four and forty-eight hour plates (Fig. 2). She was operated upon April 14 and a section of the appendix is illustrated in Fig. 3. The history is a typical one; the physical and roentgen signs were positive and the transitional formula high, 15.

CASE II (Case 1, Table II).—A. O., female, aged eighteen years; first seen December 28, 1915, complained for the last six years of pain in the pit of the stomach and of obstinate constipation. The pain was always immediately relieved by eating. She vomited on several occasions. On physical examination there was slight

TABLE IV.—WHITE CELL COUNT IN CHRONIC PEPTIC ULCER AND OPERATIVE FINDINGS.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Absolute transitional formula.	Operative findings.
1	6,200	68.5	0.0	1.0	1.0	62	Callous ulcer at the lesser curvature.
2	7,600	68.0	0.0	1.0	1.0	75	Indurated ulcer at the pylorus with adhesions.
3	6,200	71.5	0.0	0.5	0.5	31	Callous ulcer at pylorus; appendix appeared to be normal.
4	9,400	63.0	0.0	1.0	1.0	94	Callous ulcer at lesser curvature; appendix normal.
5	12,000	76.0	1.0	0.0	1.0	120	Perforated ulcer at posterior wall of stomach.
6	6,800	63.5	0.5	1.0	1.5	102	Callous ulcer at first portion of duodenum; removed appendix, normal.
7	9,600	71.5	0.5	2.0	2.5	240	Soft ulcer at first portion of duodenum; appendix normal.
8	5,800	68.0	1.0	1.0	2.0	116	Pyloric obstruction due to large callous ulcer; appendix normal.
9	7,200	69.0	1.0	0.0	1.0	72.0	Callous ulcer at first portion of duodenum; appendix normal.
10	9,300	60.0	0.0	3.0	3.0	279	Large indurated ulcer at posterior wall of duodenum; appendix normal.

TABLE V.—WHITE CELL COUNT IN MISCELLANEOUS CONDITIONS AND OPERATIVE FINDINGS.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Absolute transitional formula.	Operative findings.
1	9,200	55.0	0.0	2.0	2.0	184	Pericholecystic adhesions.
2	16,800	84.0	1.0	0.0	1.0	168	Thick gall-bladder and stones.
3	5,600	65.0	1.0	1.0	2.0	112	Hour-glass stomach caused by adhesion band extending from liver to stomach.
4	11,400	74.0	6.0	5.0	11.0	1254	Gall-stones; fistula between gall-bladder and colon; no appendectomy.
5	23,000	75.5	0.0	5.0	5.0	1150	Perforated duodenal ulcer; right-sided subphrenic abscess.
6	5,000	68.5	0.5	0.5	1.0	50	Sclerosis of the pancreas.
7	11,200	59.0	2.0	0.0	2.0	224	Gall-stones.
8	6,900	64.0	0.0	0.0	0.0	0	Gall-stones.
9	7,600	71.0	1.5	1.5	3.0	228	Stone in left kidney.
10	6,000	68.0	2.0	0.0	2.0	120	Stone in right kidney.

TABLE VI.—WHITE CELL COUNT IN PATIENTS WHOSE APPENDICES HAD BEEN PREVIOUSLY REMOVED.

Case number.	White blood corpuscles.	Polynuclears, %.	Large mononuclears, %.	Transitional leukocytes, %.	Relative transitional formula.	Present illness.
1	12,400	63.0	6.0	0.0	6.0	Perforated duodenal ulcer.
2	8,200	54.0	6.0	1.0	6.0	Floating kidney.
3	...	55.5	2.5	6.5	9.0	Postoperative adhesions around appendix.
4	5,600	66.5	3.0	5.0	3.0	Cecum mobile.
5	9,200	71.0	2.0	1.0	3.0	Postoperative adhesions and intestinal stasis.
6	12,800	60.5	4.0	6.0	10.0	General visceroptosis.
7	10,000	40.0	3.0	3.0	6.0	Ascaris lumbricoides.
8	4,000	55.0	2.0	6.0	8.0	Bleeding gastric ulcer.
9	5,400	60.0	0.0	6.0	6.0	Postoperative peri-appendicular adhesion.
10	9,400	52.0	0.0	8.0	8.0	Asthenic gastric catarrh.
11	6,100	68.0	2.5	0.0	2.5	Spastic constipation.
12	4,200	61.0	0.0	0.0	0.0	Hepatoptosis.
13	...	71.0	0.0	5.0	5.0	General itching of the body of unknown origin.
14	5,400	60.0	0.0	0.0	0.0	Postoperative adhesions.

tenderness in the epigastric region. No tenderness was elicited by palpation in the appendicular region or by Meltzer's method, and digital rectal examination was negative. There was a slight microscopic stagnation of food on a fasting stomach and a marked hyperchlorhydria after an Ewald test breakfast. The stools were positive for occult blood on three different occasions. Fluoroscopic examination and radiographic findings showed subtonic type of stomach, no tender pressure-points at curvatures of stomach or at the pyloric ring, no niche and the duodenal cap regular and well filled. There was a large gastric residue nine and a half hours after ingestion of the barium meal, and the terminal ileum was found to be slightly filled twenty-four hours later. The appendix was not visible. A diagnosis of gastric ulcer was made. The patient was put on a Lenhardz diet for two weeks. She improved and remained well under ulcer therapy until April 15, 1916, when all the symptoms recurred.

Operation, May 25, 1916, revealed chronic inflammation of the appendix with peri-appendicular adhesions. The gall-bladder and pancreas were normal and no ulcer found in the stomach or duodenum. It is quite evident that this case simulated gastric or duodenal ulcer. The diagnosis of appendicitis was not made prior to the operation because the value of the transitional leukocytosis was then underestimated.

CASE III (Case 1, Table III).—A. H., male, aged thirty-one years, was first seen September 18, 1917. For the past eleven years he suffered from indigestion and attacks of pain in the pit of the stomach, which radiated to the lower right quadrant of the abdomen; pain had no relation to food and was more intense on laughing,

coughing or sneezing. He vomited with blood at the onset of his illness. He was treated at Wegele's Sanatorium in 1913 for gastric ulcer, and the same diagnosis was made by Prof. Adolph Schmidt in Frankfurt. On examination he showed tenderness in the continuation of the right axillary, scapular lines at the level of the gall-bladder, and marked tenderness in the appendicular region by Meltzer's and Bastedo's methods. There was no stagnation of



FIG. 4.—Section of the appendix showing complete destruction of mucosa and obliteration of lumen by a mass of fatty and fibrous tissue.

food and the acidity of the gastric contents was normal. Occult blood tests of the stools were repeatedly negative. Urine analysis, Wassermann reaction, fluoroscopic and radiographic examination of the stomach were negative. There was a stasis in the large intestines seventy-two hours after ingestion of the barium meal, and after a barium enema the transverse colon appeared to be markedly ptotic, sharply kinked at the proximal portion and adherent to the cecum. A diagnosis of pericholecystic adhesions

and chronic appendicitis was made. At operation the appendix was found buried in adhesions. A strawberry gall-bladder, with adhesions, was also removed. There was no ulcer of the stomach or duodenum and the pancreas appeared to be normal. (Fig. 4 shows section of the appendix.)

Transitional leukocytosis, tenderness elicited by Meltzer's and Bastedo's methods, roentgen signs and the tender pressure-points in the right axillary, scapular line at the level of the gall-bladder, all added to make the diagnosis of appendicitis, and pericholecystic adhesions.^{10 11}

CASE IV (Case 4, Table III).—W. M., male, aged forty-three years, first seen October 31, 1917, was suffering for a number of years, with vomiting and sharp pain in the pit of the stomach immediately after meals. Examinations revealed tenderness in the epigastric region. The laboratory and roentgen findings pointed to an ulcer of the stomach. There were no symptoms or roentgen signs or other physical findings to lead one to suspect an associated appendicitis. At operation a large indurated ulcer was discovered at the lesser curvature near the pylorus. There were adhesions between the gall-bladder and the duodenum. The appendix was removed and found to be normal on gross examination, but microscopically scattered through the mucosa were many phagocytic cells filled with hemosiderosis pigment. The epithelium was normal, but there was some fibrous thickening of the submucous coat and occasional fibrous scarring of the muscular coats. These changes suggested a mild chronic appendicitis. The high transitional formula was the only aid for the diagnosis of appendicitis.

CASE V (Case 11, Table III).—K. G., male, aged twenty-nine years, first seen April 2, 1918, gave a history of indefinite abdominal pain appearing at intervals of several months. He had his first attack five years ago. Since then he was observed by several internists and a complete roentgen examination of the gastrointestinal tract had been made. A definite diagnosis was not reached. However, based upon a transitional formula of 8, a positive diagnosis of appendicitis was made in spite of negative physical and roentgen signs. At operation, April 20, 1918, a kinked and thickened appendix with adhesions was found and a scar resulting from a healed ulcer at the extreme portion of the duodenum was discovered. Microscopically some fibrous thickening of the muscular coat with slight fatty replacement was observed.

CASE VI (Case 2, Table III).—F. B., female, aged thirty years; first seen September 29, 1917, complained of indigestion for many years, her condition becoming worse during the past year. Her

¹⁰ Friedman, G. A.: Pericholecystic Adhesions Dyspepsia and its Diagnosis, New York Med. Jour., 1918, cvii, 337.

¹¹ Friedman, G. A.: Abstract of Discussion on Dr. Smithies's paper: Pericholecystic Adhesions, Jour. Am. Med. Assn., 1918, lxxii, 1808.

chief complaint was a sensation of pressure or load in the epigastrium. She was extremely nervous, suffered a great deal from obstinate constipation, alternating with diarrhea, and in the course of one year she lost forty pounds in weight. Various diagnoses were made, such as nervous dyspepsia, auto-intoxication and even acidosis. She appeared emaciated, her weight being eighty-eight pounds. She showed marked dermatographia and had extreme tenderness in the continuation of the axillary line at the level of the gall-bladder. Tenderness was also elicited in the appendicular region on palpation by Meltzer's method and on rectal examina-

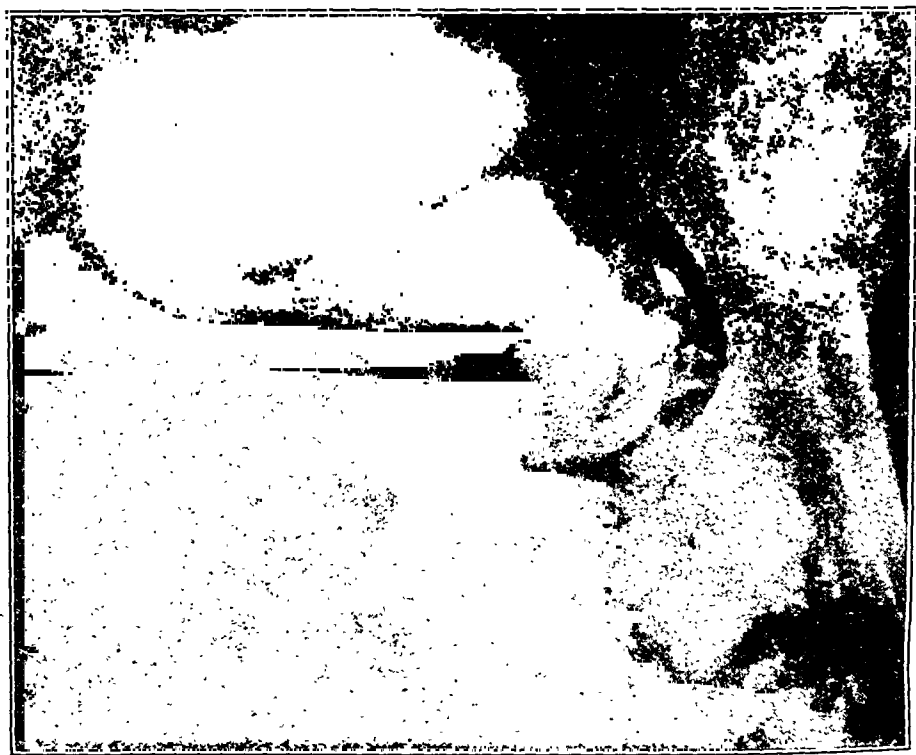


FIG. 5.—Lantern-slide reproduction of roentgenogram showing barium-filled appendix seventy-two hours after ingestion of the barium meal.

tion. There was no stagnation of food, but the free hydrochloric acid was strongly positive. The stools and urine analysis were negative except for slight traces of sugar on several occasions. Indican was always in excess. Fluoroscopic and radiographic examinations showed marked ptosis of the stomach and of the transverse colon. The appendix was visible (Fig. 5) in twenty-four-, forty-eight- and seventy-two-hour plates. A diagnosis of cholecystitis was made. Appendicitis was not entertained because of the low transitional formula (2), although there were intestinal stasis and a visible appendix. At operation, October 19, 1917, adhesions between the gall-bladder, duodenum and pylorus were

found. The gall-bladder was atrophic. Cholecystectomy was performed. Adhesions were noticed around the appendix, which was removed. On microscopic examination, however, the appendix was normal.

This case illustrates that physical and roentgen signs may be present without an actually diseased appendix, but the low transitional formula helped, indeed, to rule out appendicitis.

SUMMARY. 1. Transitional leukocytosis or an increase in large mononuclears and in transitional leukocytes, or an increase in either of them, was found in the blood of 87 per cent. of patients in whom evidence of chronic appendicitis was obtained.

2. There was no transitional leukocytosis in the blood of patients in whom evidence of chronic peptic ulcer was obtained or in the blood of those in whom cholecystitis, renal stones or other organic abdominal conditions were found at operation.

3. A transitional leukocytosis was found in patients in whom appendicitis was present, with other organic abdominal conditions.

4. A hyperleukocytosis and a polynuclear leukocytosis are not as frequently found in chronic appendicitis as a transitional leukocytosis.

5. A transitional leukocytosis as a diagnostic aid is superior to such roentgen signs which are supposed directly or indirectly to point to a diseased appendix.

6. Transitional leukocytosis often persists in the blood after an appendectomy is performed.

CASE OF MEDIASTINAL HODGKIN'S GRANULOMA, WITH PERFORATION OF THE CHEST WALL.

BY M. W. LYON, JR., M.D.,

SOUTH BEND, INDIANA.

(From the Laboratory Service, Walter Reed General Hospital.)

THE case of Hodgkin's granuloma here described is chiefly of interest because of the mediastinal location and large size of the mass of new tissue and its pressure erosion through the anterior chest wall. Similar cases are not unknown and have been described before, but they are comparatively infrequent. Some of the sarcomas of the thymus that have been described are perhaps cases having an association of cells resembling those of Hodgkin's disease. Ewing¹ has described three cases of thymic tumors, calling them thymomas, and has reviewed the literature of the subject.

¹ Surg., Gynec. and Obst., April, 1916, xxii, 461-472.

Two of his cases are mentioned as partaking of the nature of Hodgkin's granuloma.² While admitting the possible, if not probable, thymic origin of this new growth of tissue, it seems more logical to refer to it as a Hodgkin's granuloma rather than a thymoma or sarcoma, since the neoplastic mass is of that general type of tissue characteristic of Hodgkin's disease. None of the sections that have been examined reveal tissue identifiable as thymic. There is a certain lack of agreement by authors as to the nature of Hodgkin's disease. Mallory,³ for example, refers to it as lymphosarcoma. Most authors consider it a well-characterized disease of the lymph nodes, probably of infectious origin. MacCallum⁴ and Ewing⁵ regard it as such and give careful descriptions of the lesions with references to the important papers. Aside from the unusual location of this growth and the absence of involvement of the cervical nodes, this case appears rather characteristic of Hodgkin's granuloma.

CLINICAL HISTORY. This case was not seen by me during life, and the following clinical history is compiled from the various records on file in the hospital. They represent observations of various clinicians during the long stay of the patient.

Family and Personal History. Age, twenty years. Previous occupation, railroad fireman. Tropical service, none. Denies use of alcohol. Five brothers, living and well; mother, living and well; father, probably living and well. Denies venereal infection.

History of Present Disease and Subjective Symptoms. In April, 1917, he stumbled over a trunk and struck his chest on a cot; there resulted swelling and soreness for several days, but no abrasion. The patient was not certain that the swelling ever disappeared, but noticed about a month later that there was a swelling at the site of the injury or perhaps a little higher. This increased in size; enlargement was not painful. At this time the patient noticed shortness of breath on exertion and at drill. Patient was relieved from active duty and placed on recruiting service, owing to impaired physical condition. The patient was finally sent to this hospital, October 31, 1917. His general condition was good except for a growth in the chest, the growth being about two and a half inches above and to the inner side of the right nipple. The bloodvessels in and around the area were prominent and enlarged. On November 2, a roentgen-ray examination showed a mass in the right chest and mediastinum, probably sarcoma. November 9 a double-plus blood-Wassermann reaction was reported by the Army Medical School and antisymphilitic treatment insti-

² The present case has been seen by Dr. Ewing and he has pronounced it as another example of thymoma belonging to the Hodgkin class.

³ The Principles of Pathological Histology, 1914, p. 326.

⁴ A Text-book of Pathology, 1917, p. 791.

⁵ Neoplastic Diseases, 1919, pp. 352 and 895.



FIG. 1.—Perforation of chest wall by growth.

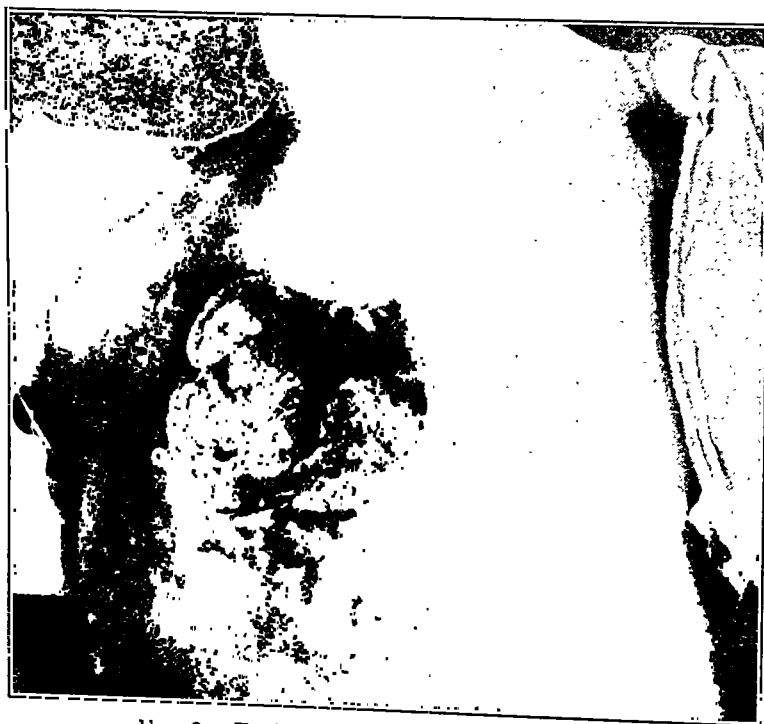


FIG. 2.—Perforation of chest wall by growth.

tuted. Two other positive reports were obtained. Antiluetic treatment had no effect and was abandoned. Roentgen-ray treatment was tried, but without lessening the growth. About the middle of April, 1918, the chest wall became perforated (Figs. 1 and 2). The exposed tissues became infected and underwent necrosis and sloughing. The chest opening was very foul and the edges of the wound inflamed until dichloramin-T in chlorcosane was used, after which treatment the necrotic condition disappeared and more or less healthy granulations formed, so that the edges of the opening into the chest then appeared healthy. About the last week of June there was a sudden discharge of pus from the chest, and from that time there continued considerable purulent discharge. The patient was bedridden for months, but sat up in a wheel-chair at times. Death from toxemic exhaustion, August 15, 1918.

Objective Symptoms. Normal weight 145 pounds and on admission 135 pounds, weight progressively diminishing. Heart rapid, irregular, was displaced downward and to the left. Respiration difficult.

	Pulse.	Respiration.	Temperature.
Nov., 1917...	74 to 120, usually about 100	20 to 30, usually about 20	98° to 103.8°
Dec., 1917...	80 to 126, " 110	20 to 36, " 24	97° to 102.0°
Jan., 1918...	60 to 124, " 100	20 to 32, " 22	99° to 101.8°
Feb., 1918...	90 to 124,, 90 to 100	20 to 24, " 20	98° to 103.4°

Laboratory Findings. December 22, 1917, roentgen ray showed a large tumor in the right mediastinum, referred to as a sarcoma (Fig. 3). Urine: traces of albumin and a few leukocytes. Blood: red blood cells, about 4,000,000; hemoglobin, 75 to 80 per cent.; white blood cells, 13,000 to 33,000; differential count: small mononuclears, 3; transitionals, 1 to 3; eosinophiles, 0 to 2; neutrophiles, 82 to 84; basophiles, 0 to 1. No laboratory examinations made since December, 1917.

AUTOPSY REPORT, INCLUDING MICROSCOPIC EXAMINATION OF TISSUE. *Body.* A young adult, white male, 1660 mm. in length; body warm; rigor mortis, absent; livor mortis, absent. Skin, very pale. General emaciation, very marked. There are several bedsores in the gluteal region. Hair, brown. Irides, blue; pupils, 7 mm. in diameter each. In the upper part of the chest, somewhat to the right of the median and including the median line, is a large irregular opening of general oval shape, 130 x 100 mm. (Figs. 1 and 2). This opening extends into the right chest cavity. A considerable portion of the sternum and adjacent portions of the ribs and the right clavicle have been eroded away. The skin surface of the edges of the opening in the chest is covered with normal epidermis, beneath which is what appears to be new-formed fibrous tissue, having the general appearance of a recently healed wound. The pleural surface of the edges of the opening

appears to be composed of infected and necrotic tissue. The exposed ends of bones are eroded and necrotic. The color at the base of the opening in the chest varies from pink to greenish gray. The manner of formation of the chest opening appears to have been primarily from pressure necrosis, and the continued enlargement appears to have occurred in part at least by necrosis of the skin and subjacent tissue immediately behind the edges of the opening (Figs. 1 and 2, lower and right hand, with reference to the patient, margin), making secondary openings, the intervening bridges of tissue between these and the large chest opening subsequently necrosing away.

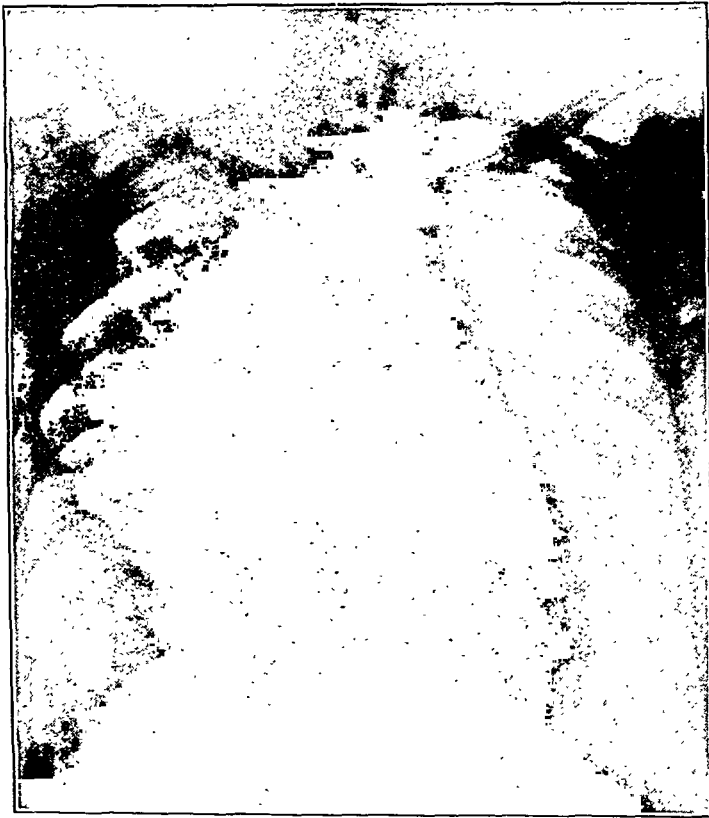


FIG. 3.—Roentgen-ray picture of growth in chest. Made by Major J. H. Selby, M. C., U.S.A.

Thorax. The sternum and costal cartilages were removed without difficulty and were not adherent to the subjacent tissues. Diaphragm at the fifth interspace on each side.

In the left pleural cavity are a number of old fibrous adhesions; no excess of fluid. In the right pleural cavity are many old fibrous adhesions and a large amount of purulent material. The opening in the chest wall leads into this cavity. This purulent material is to a considerable extent pocketed between the lobes of the lung and between the lung and the posterior chest wall. This posterior

pocket penetrates the posterior pleural lining and extends down through the soft tissue behind the peritoneum into the region lying alongside of the lumbar spine as far as the sacroiliac joint and is filled with thick yellow pus. Transverse processes of the lumbar vertebrae and parts of the lower ribs are in this pus cavity, and these bony structures are more or less eroded and roughened; 970 c.c. of pus in the pleural cavity and about 650 c.c. in the retro-peritoneal abscess. Cultures from this pus yielded *Staphylococcus pyogenes*.



FIG. 4.—New growth surrounding trachea and bronchus, invading and compressing lung.

The pericardium contains a slight excess of clear serous fluid. Aside from an occasional small nodule (3 mm.) at the anterior inferior border the pericardium is essentially uninvolved. Its anterior aspect is not covered with any of the new growth. In the location of the thymus are several large irregular nodular masses,

the lowest of these just over the base of the heart and 20 to 50 mm. in diameter.

The mediastinum is occupied by a large mass of new tissue which extends into the right pleural cavity. This mass of tissue roughly measures 150 mm. in length by 75 mm. in width and thickness. It invades and compresses the lung tissue on the right side, so that only about half the normal amount is present. What there is of the lung appears necrotic and atelectatic. This large, hard, yellowish-gray mass extends firmly around the trachea and bronchi (Fig. 4) and invades the neighboring lymph nodes, which are enormously enlarged, firm and hard. On section these enlarged nodes present a light yellowish-gray color and the larger ones often have rather extensive soft necrotic centers. These nodes vary in size from about 5 mm. in the posterior mediastinum to the very large mass of new tissue in the anterior part of the chest.

Cervical and axillary lymph nodes are not enlarged.

Abdomen. Abdominal fat is essentially lacking. There is 580 c.c. of slightly turbid fluid in the peritoneal cavity, but the serous surfaces appear normal.

Many of the abdominal lymph nodes are enlarged and hard, resembling those of the thorax. Noteworthy among the glands so affected are the superior gastric nodes, hepatic nodes and pancreaticosplenic nodes.

From the posterior attachment of diaphragm downward the retroperitoneal nodes, including the iliac nodes, form a more or less fused, solid, irregular mass. The individual masses of new growth vary in size from 10 to 100 mm. in their greatest diameters. The inguinal nodes are also involved in this process, some of them having a diameter of 30 to 50 mm. Enlarged nodes can also be palpated along the inner aspect of the right thigh as far down as the knee.

Microscopic examination of the lymph nodes of the size of about 10 mm. in longest diameter shows them to be composed of an indefinite mixture of young fibrous tissue, small mononuclear cells, with deep staining nuclei, larger cells, with rather oval vesicular pale staining nuclei, a small number of eosinophiles and cells of very large size as compared with any of the others, containing a single large rounded or lobed nucleus or two or more nuclei. The cytoplasm of these large cells is ill-defined; their nuclei are pale staining, but with a dark staining, sharply defined outline and irregularly distributed, dark staining, chromatic streaks and spots within (Fig. 5 and 6). The original lymphoid tissue has been entirely replaced by tissue composed of the above association of cells. The larger, enormously swollen lymph nodes, measuring several centimeters in diameter, show large areas of the above association of cells, with areas of marked fibrous-tissue formation. In the bronchial lymph nodes some anthracotic pigment may be seen in

these fibrous portions. Necrosis of the tissue is seen in the central portion of many of the larger nodes.

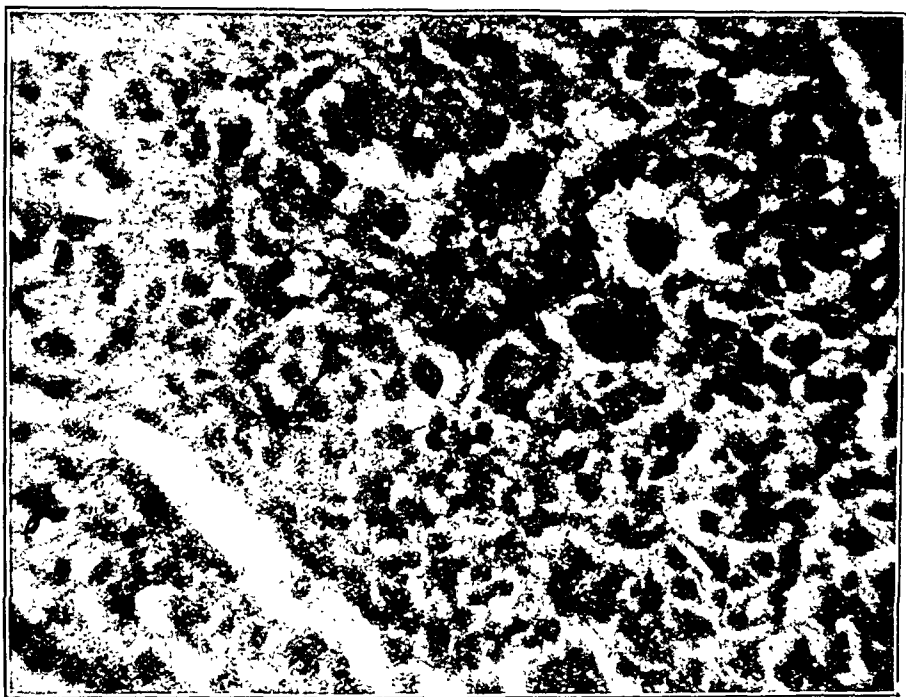


FIG. 5.—High power. Reed giant cells, fibroblasts, lymphocytes.

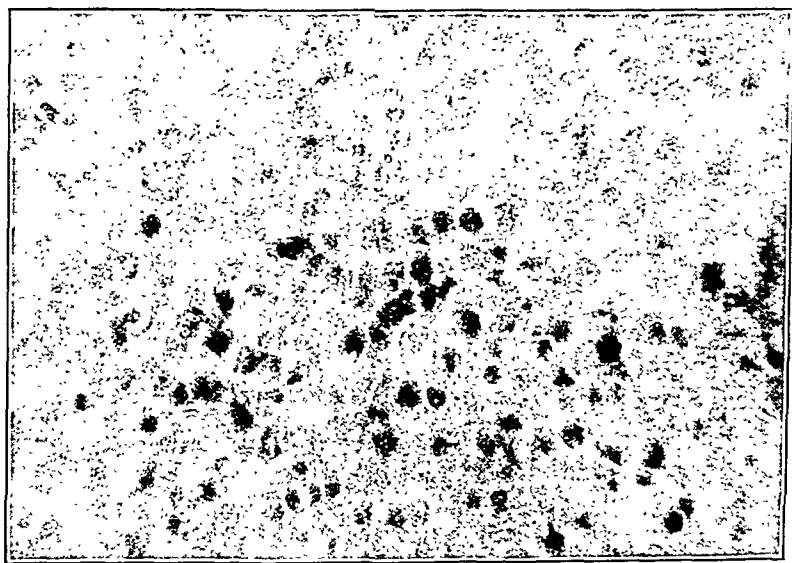


FIG. 6.—High power. A group of small cells, about a third of them are eosinophiles.

Heart. The heart is small, its musculature soft and flabby; leaflets and cusps of all the valves appear normal. The aorta appears small. On the surface of the heart, particularly along

the courses of the coronary vessels, are found a few very small nodules usually about 1 or 2 mm. in diameter, hard and of a yellowish-gray color. The largest of these nodules measures about 5 mm. in diameter. They appear to be metastatic growths along the lymphatics of the epicardium.

Microscopic examination shows no special pathology of the myocardium. The metastatic growths seen on the surface are accumulations of small round lymphoid cells, endothelioid cells and a few fibroblasts. Only very rarely may be found a mononuclear giant cell. No eosinophiles are seen. In some places the lymphoid cells may be seen pushing in between the fibers of the myocardium just beneath the epicardium (Fig. 7). The rarity of the mononuclear giant cells in the tissue is perhaps accounted for by the fact that the nodules are small and newly formed.

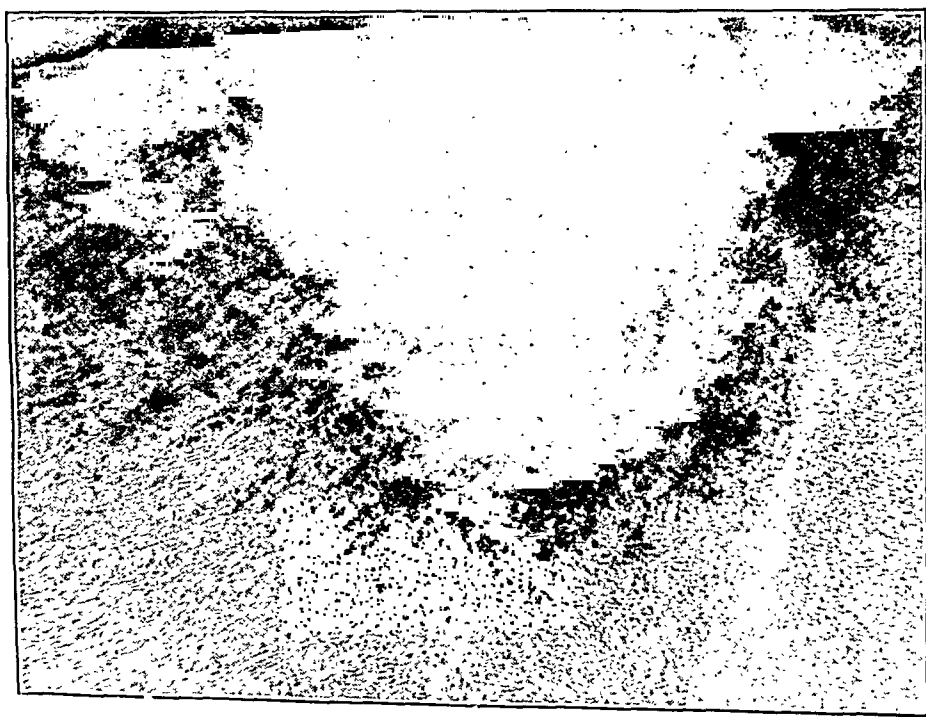


FIG. 7.—Low power. Nodule invading heart muscle.

Lungs. About one-half of the right lung anteriorly and medially is replaced, or at least its position is occupied, by a great bulk of tissue having the characteristics of Hodgkin's granuloma, as already described under the thoracic lymph nodes. The posterior half of the lung is dark, meaty red in color and appears atelectatic and necrotic.

The left lung feels everywhere soft and crepitant and shows a considerable degree of anthracosis.

Microscopic examination of the right lung (Fig. 8), where the tumor-like masses are pressing on it, shows the alveoli to be elon-

gated and flattened and much compressed, due to the pushing inward on them of the rounded growing mass. The lung tissue is not only compressed by the growth but is infiltrated and replaced by it. The growth follows, for the most part, the bronchi and bronchioles. The earliest manifestation appears to be an increase of connective tissue about the vessels and bronchioles, with the presence of many small mononuclear cells and some cells with larger, rather vesicular nuclei. The characteristic giant cells are not found in these apparently early lesions, and eosinophiles are equally lacking. Usually, in the invaded parts of the lung, it is with difficulty that remains of lung tissue can be seen in the mass. The most persistent structure is the bronchiole. Often one of these is

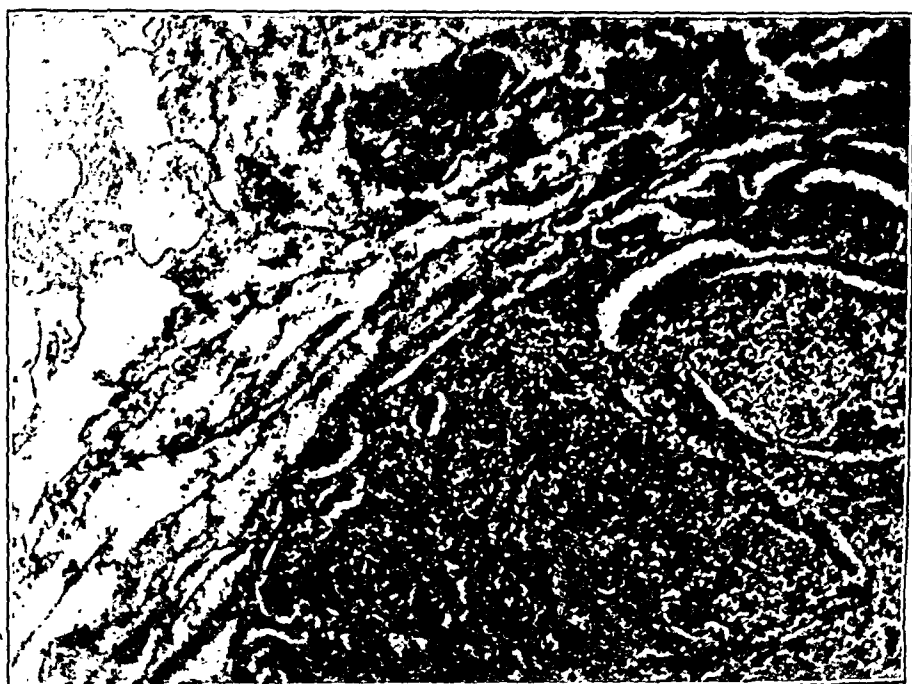


FIG. 8.—Low power. Edge of small nodule in lung.

seen with a fairly well formed lumen lined with characteristic columnar cells, surrounded on all sides by dense masses of the new invading cells, with no evidence of lung parenchyma near it. In some sections, embedded in the mass of new tissue complex, are ill-defined spaces compressed and lined with cuboidal cells. On studying the edges of the tissue invading the lung there appear to be remains of walls of alveoli the epithelium of which is no longer flattened. Examination of the edges of such places indicates that the new growth can follow along the walls of the alveoli as well as along the paths of the bronchi and bronchioles. Rather seldom may be seen in the lung tissue proper, unassociated with bronchioles or bloodvessels, small nodules (about 1 mm. or less)

of the new invading cells, typical of Hodgkin's granuloma in all respects except that the eosinophiles are lacking or at least very inconspicuous. The unattacked parts of the lung show nothing of special interest. The air vesicles may be somewhat dilated or in other places compressed. The capillaries do not appear engorged. Usually desquamated epithelial cells are present in the alveoli, often in rather large numbers. Red blood cells are frequently found in the alveoli as well.



FIG. 9.—Section of spleen showing nodules of new tissues.

Spleen. The spleen, 120 x 70 x 45 mm., has the usual slaty purple color. Showing through the dark color of the organ are seen, here and there, yellowish nodules. On section the bulk of splenic pulp is of an essentially normal dark reddish-brown color. In it are seen many yellowish nodules varying in diameter from 1 to 15 mm. They are much more numerous on section of the organ than would be suspected from external examination (Fig. 9). Roughly, these yellowish masses appear to make nearly half the bulk of the organ. Microscopically, in the parts of the organ not invaded by the growth, the splenic tissue shows no noteworthy changes. The splenic venules are very distinct and usually well filled with blood. There are places in the pulp in which are many red cells. There is no sharp line of demarcation between the splenic tissue and the tissue characteristic of Hodgkin's disease.

Some of the larger nodules have undergone necrosis and essentially none of the characteristic cells are present in it. One section shows a small beginning nodule in the adventitia of one of the arterioles.

Liver. The liver presents a normal reddish-brown color. On section it cuts with about normal firmness and presents a normal brownish color in which the bloodvessels are moderately conspicuous. No metastatic growths are seen on its surface or in any of several sections made through the organ. Microscopic examination shows the liver cells granular and with well-staining nuclei. The sinusoids of the periphery of most of the lobules are rather well filled with blood and the liver cells correspondingly compressed.

The gall-bladder contains about 10 c.c. clear golden-yellow bile; its ducts are patent; no stones are present.

Pancreas.—The pancreas appears normal, with the exception of a terminal portion of the tail. In this end, for nearly one-third or quarter of the organ, are found hard, oval nodules ranging in size from less than 1 mm. up to those which measure about 15 mm. in the longest diameter. On section these masses resemble those found in the various lymph nodes. Microscopically the pancreatic tissue appears essentially normal except at the left extremity. Here the nodular masses noted macroscopically show the same association of cells as found in the mediastinal lymph tissue. Some show areas of central necrosis. Eosinophiles are very rarely seen in this invading tissue. There does not appear to be much of an infiltration of the pancreatic parenchyma by the new growth, but it seems to stimulate a marked proliferation of the interlobular connective tissue. Small beginning nodules are found in the thickened interlobular tissue (Fig. 10).

Alimentary Canal. The alimentary canal shows no abnormalities visible externally; its various portions were unopened.

Kidneys. The left kidney measures 120 x 55 x 35 mm. On section it presents a very pale appearance, with a cortex about 7 mm. in thickness. The bloodvessels are well defined in it. Capsule strips readily leaving a smooth surface in which the stellate veins are rather conspicuous. In the interior of the organ is a yellowish nodule with a diameter of 5 or 6 mm. The right kidney is essentially like the left, but contains no nodules.

Microscopic examination shows no striking pathology of the kidneys except for the metastatic nodule just referred to. The tubular epithelium is granular and flattened; tubules appear dilated and are usually filled with some loose reticular or granular matter. Their nuclei stain well. The glomeruli are usually somewhat shrunken; occasionally their capillaries are distended and sometimes there is granular matter in the space between the tuft and the capsule. The nodule referred to macroscopically is composed of an association of cells characteristic of Hodgkin's granuloma,

with the exception of the eosinophiles. The growth has followed the interstitial connective tissue gradually crowding out the renal parenchyma. But in the nodule may be clearly seen remains



FIG. 10.—Low power. Nodule invading pancreatic tissue.

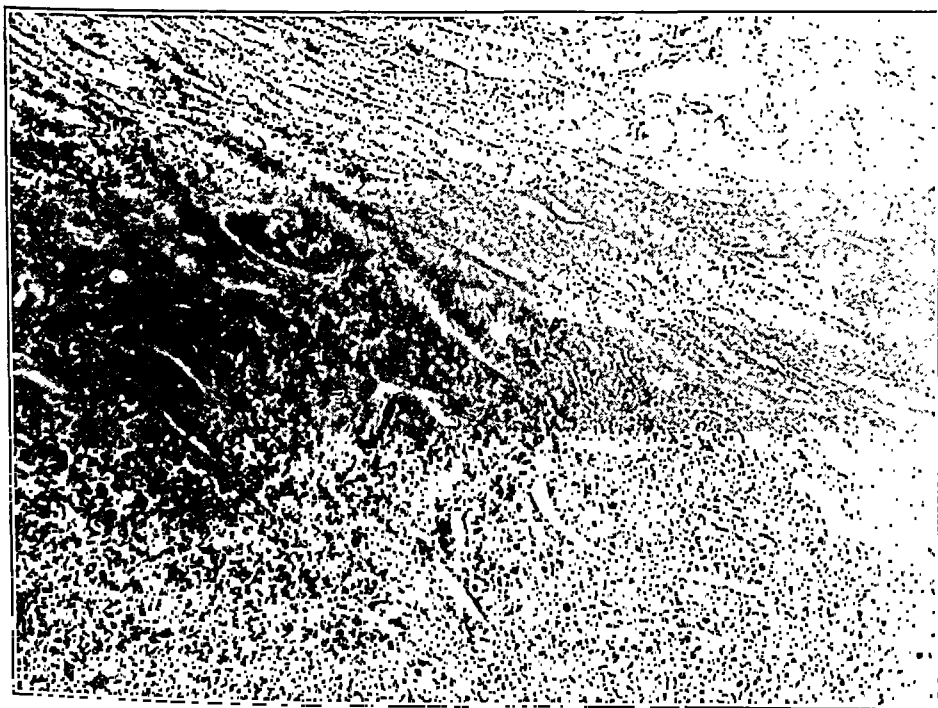


FIG. 11.—Low power. Edge of small nodule in kidney.

of tubules with well-preserved epithelial cells. Less frequently a glomerulus is seen caught in the nodule. The lumina of the included tubules, which are not very frequent, may be empty, or more or less filled by granular, hyaline material, or sometimes cells probably derived from the epithelium. At the periphery of the nodule the kidney substance is seen to be distinctly pressed upon and the nodule has a well-defined edge (Fig. 11). Microscopic examination of the right kidney shows essentially the same characteristics as seen in the left except for absence of metastatic nodule.

Other Organs. The *testicles* show no abnormality.

The *bladder* appears normal in all respects.

The *prostate* gland measures 20 mm. anteroposteriorly and 20 mm. laterolaterally.

SUMMARY. A case of neoplastic growth having the tissue characteristics of Hodgkin's granuloma situated primarily in the mediastinum is described. It occurred in a young adult white male of good previous and family histories. Its duration was sixteen months. The neoplastic mass caused pressure erosion of the chest wall; the right pleura became infected and a retropleural and retroperitoneal abscess developed, the patient dying of toxemia and exhaustion. The chief pathological findings were extension of the mediastinal neoplastic growth into the right lung, involvement of the bronchial and mediastinal lymph nodes, of many abdominal lymph nodes and of the retroperitoneal and inguinal nodes. Metastatic-like growths were found in the unenlarged spleen, in the tail of the pancreas, in the right kidney and in the epicardium and beginning to invade the myocardium. The liver and the cervical, maxillary and axillary lymph nodes were uninvolved.

FIELD OBSERVATIONS ON BLOOD-VOLUME IN WOUND HEMORRHAGE AND SHOCK.¹

BY ROGER I. LEE, M.D., LATELY LIEUT.-COL. M.C.,
CAMBRIDGE, MASS.

THE value of transfusion and infusion in hemorrhage, which had already been established before the war, received abundance of confirmation during the war. Nevertheless, during most of the war little progress was made beyond the outstanding fact that either transfusion or infusion was a life-saving procedure in certain cases. In other cases neither of these procedures seemed to be of particular benefit. There grew up the advocates of transfusion

¹ Read at the meeting of the American Climatological and Clinical Association, June, 1919.

on one hand and of the infusion of blood substitutes on the other. In each instance conclusions were drawn from clinical results.

It was obviously desirable to establish criteria; in the first place to determine the therapeutic application of either or both of these procedures, and in the second case, in order to evaluate properly these methods. While there may be many other factors involved in the transfer of blood or of blood substitutes to the patient, there are two fundamental considerations which must be granted. It must be obvious that by transfusion one transfers a certain volume of fluid, and one also transfers a certain amount of oxygen-carrying substance. By infusion one merely increases the blood volume of the patient.

Robertson and Bock,² utilizing the method of Keith, Rowntree and Geraghty,³ studied the blood-volume in certain cases of wound hemorrhage. They found that with the estimation of the blood-volume and of the total hemoglobin one was able to construct rather more definitely than had been done before indications for the use of transfusion or infusion, or both. The method which they used was obviously not entirely suitable for work under the usual conditions in the field. It is apparent that if one estimates any of the ordinary constituents of the blood and then dilutes the blood with a known amount of fluid which does not contain that constituent, it is possible to derive a formula by which, more or less roughly, the blood-volume can be calculated. After consideration of the various possible methods it seemed most feasible to utilize hemoglobin determination. In the first place it was necessary to estimate the hemoglobin by some reasonably accurate method in order to acquire part of the necessary data. In the second place it was felt that the hemoglobin determination could be made quickly, with very little apparatus and fairly accurately. The method of determining the hemoglobin was what might be called a home-made modification of Sahli's method. Using the well-known principle of that method, a goodly number of hemoglobinometers could be constructed anywhere if one had small test-tubes and decinormal hydrochloric acid. Arbitrarily an assumed normal blood, or better, pooled normal bloods were taken as standard, 100 per cent. Previous experience had indicated that this method was fairly satisfactory, and that when read in the daylight different observers constantly read within two points. Furthermore, since the comparative readings were in general made within a few moments and with the same apparatus the general errors were minimized. The actual procedure was as follows: The hemoglobin was estimated from the ear or preferably from the arm vein, then 500 c.c. or other

² Memorandum on Blood Volume after Hemorrhage. Reports of the Special Investigation Committee on Surgical Shock and Allied Conditions, British Medical Research Committee and Jour. Exp. Med., 1919, xxix, 139 and 155.

³ Arch. Int. Med., 1915, xvi, 547.

fixed amounts of either normal saline or of gum acacia in normal saline were given intravenously. As soon as possible after the infusion the hemoglobin was again estimated in the same way as before. From these estimations one then deduced the blood-volume. For example: A patient's hemoglobin was 80 per cent. before the introduction of 500 c.c. caused a 10 per cent. drop. Therefore, $10 : 80 :: 500 : x$ or the blood-volume, which is 4000 c.c. after the infusion or 3500 c.c. before the infusion. It was necessary to assume that the normal blood volume ranged between 5000 and 6000 c.c., depending upon the size of the individual. One compared the blood-volume actually obtained with the presumed normal for that individual. From this one also estimated the absolute hemoglobin in terms of percentage. From these data it was possible to determine in the first instance if the patient needed any increase in blood-volume, and, furthermore, if he needed any increase in the oxygen-carrying constituent.

The observations upon which this paper is based were made in field hospitals and evacuation hospitals in the A. E. F. Most of these hospitals had wards designated as "shock wards," to which patients in so-called shock were sent. In practice it worked out that most of the very seriously wounded cases were sent to this ward. The presenting problem was to get the patient in shape for transportation or for operation. Naturally, some of the cases were post-operative. Most of the patients were studied within twenty-four hours of injury. Owing to the conditions it was never possible to keep patients more than a few days for continued observation.

In all cases careful and repeated blood-pressure readings were made and in general the blood-pressure reading was taken to represent the condition of the patient with full regard for all of the varying factors, hemorrhage, shock and infection. In this work no attempt was made to study the important factor of blood-flow. The importance of blood-flow was, of course, recognized, irrespective of the question of how much blood-flow depends upon blood-volume.

In general it was found that in order to furnish a reasonable basis for recovery, patients should have at least 65 per cent. of their blood-volume and at least 25 per cent. of their total hemoglobin. Owing to the nature of this work it was obviously impossible to check up very definitely exactly at what point of either blood-volume or total hemoglobin the positive indications for transfusion or infusion came. It is evident that each case created a special problem because no two cases were alike. In some cases there was a great increase in the element of infection; in others there was the necessity of providing against an operation of more or less severity, which certainly would augment the element of shock. Furthermore, the element of shock was always a variable and undeterminable factor. It was the experience early in the work that hemorrhage

and shock were very closely associated and accumulated experience was unable to separate clearly in my mind the manifestations which could be attributed to shock. Consequently it was our custom in field and evacuation hospitals to regard wounded cases in a serious condition as suffering from hemorrhage and shock. In the paper I have continued this somewhat reprehensible practice. So far as I know we studied no cases of shock without hemorrhage.

Our results show that seriously wounded men, even without the history of hemorrhage, usually had lost a considerable amount of blood and blood-volume. Theoretically, at least, the percentage of total hemoglobin when subtracted from 100 gives the percentage of blood loss. For example, a man presents a blood-volume of 4500 c.c. against his estimated normal of 6000 c.c., or 75 per cent. His relative hemoglobin is 80 per cent. His actual total hemoglobin is 60 per cent. Presumably he has lost 40 per cent. of his blood or 2400 c.c. However, he has replaced by fluid either from his tissues or his fluid intake or both 900 c.c., as his blood-volume deficiency is only 1500 c.c. We assume that it is the 900 c.c. of fluid addition to his depleted blood-volume which has diluted his hemoglobin from 100 to 80 per cent. Of course, this argument presupposed that the man originally had both a normal blood-volume and normal hemoglobin. In general the evidence indicates that these presuppositions are reasonably sound.

In some instances these losses represented well over half the total amount of blood. In those cases we early came to recognize a very important fact. If the blood-volume was not being restored at least to an appreciable extent the prognosis was very grave, irrespective of treatment. In other words, when natural forces tended to restore in its normal fashion the blood-volume the prognosis was relatively good. We came to recognize the fact that, contrary to the usual off-hand snap judgment, but strictly in accord with logical reasoning, if a patient presented himself at the end of twenty four hours or more with a relatively low hemoglobin, say of 60 to 80 per cent., that patient was in much better condition than one who presented himself with a hemoglobin of over 100 per cent., or the well-known phenomenon of blood concentration in shock. In the most severe cases we found an astonishingly low blood-volume, sometimes under 30 per cent. of normal and an absolute hemoglobin of under 20 per cent. It may be repeated parenthetically here that in such cases the relative hemoglobin might be normal. Such cases in our experience, unless due to very recent large hemorrhage, and unless immediately corrected by large transfusions, were fatal. It became clear that, as had been observed clinically, there was a considerable group of cases of hemorrhage and shock in which, on account of the severity of the condition, little could be expected of any remedial measures. Another not inconsiderable group was

made up of those cases who had no tremendous blood-loss but who had a blood-volume ranging around 60 per cent. In those cases the execution of the obvious indication of partially restoring the blood-volume by infusion was followed by elevation of the blood-pressure and of the apparent restoration of the patient to a condition of relative well-being.

Perhaps the most interesting group of patients was the intermediate group between the two above groups. In this group the indication was for both the restoration of blood-volume and of the oxygen-carrying constituent. In some of these cases simple transfusion was enough. Other cases required both transfusion and infusion. In some cases within a relatively short time over 1000 c.c. of blood and in addition over 1000 c.c. of fluid were administered.

Inasmuch as Robertson and Bock had previously suggested that fluids administered by the alimentary canal were taken up and retained, provided the concentration of hemoglobin was adequate, fluids were administered both by mouth and by rectum whenever possible. Furthermore, although it was fully appreciated that salt solution under the skin was, like salt solution into the veins, only temporarily held in the circulation, nevertheless both of these methods were utilized to meet the temporary emergency.

It is worthy of repetition that the continued administration of fluids in goodly amounts (usually by mouth) is necessary in practically all cases requiring transfusion. Transfusion may put them by the danger-point in regard to both blood-volume and oxygen-carrying constituent, but there remains, as a rule, a considerable blood-volume deficit which it is desirable to make up as rapidly as possible. All of the cases were controlled, as far as possible, in regard to the progress of the maintenance of an adequate blood-volume by repeated hemoglobin estimations. It must be obvious that a blood which is steadily diluting, that is with a steadily falling hemoglobin reading, is steadily increasing its blood-volume.

In the connection of prognosis, which may have some possible relation to the factor of shock, a considerable series of cases seemed to demonstrate the following hypothesis: In case the blood-volume as determined by these rough methods was maintained in a satisfactory level the prognosis tended generally to be good. However, in those cases in which the blood-volume could not be maintained, and despite all methods of fluid administration, the blood tended to reconcentrate the prognosis was bad. Cases were observed in which the tendency of reconcentration was persistent despite therapy, and in which a grave prognosis could be given on account of this tendency to reconcentration even while the blood-pressure was at a satisfactory level.

Simple observation of these patients showed that, as a rule, they had a loose skin, which in itself tended to be dry, although the

surface of the skin might be covered with perspiration. It seems logical to assume that the relatively unknown factor of tissue fluids plays a considerable part in the restoration of blood-volume and that the tissue fluids are presumably called upon and relatively exhausted fairly early in this condition. This assumption and the evidence gathered in the study of blood-volume indicates that it may be highly desirable to encourage the ingestion of fluid in all cases liable to alteration in blood-volume. It is, of course, well known that soldiers in actual conflict not only lose a great deal of fluid by perspiration, etc., but also that they have frequently a diminished fluid intake for a considerable period before their injuries. Furthermore, actual experience shows that in the interval between injury and the arrival in a field hospital there is often not only loss of blood but also loss of fluid by perspiration and a continuation of the inadequate intake of fluid. In dealing with deficiencies in blood volume it must be remembered that such deficiencies irrespective of tissue fluids, which may be regarded as a reserve, may amount to 3000 c.c. The administration of sips of water during the transportation of the patient is, of course, inadequate. In one sector it was possible to adopt a system of liberal administration of fluids at several stopping-places during the period of transportation. Observations on patients from that sector, while obviously susceptible to misinterpretation, nevertheless seemed to show definitely less tendency to the severe condition of associated wound-shock and hemorrhage and the hemoglobin estimation showed fairly constantly a satisfactory and favorable hemoglobin dilution. It is believed that the recognition of the importance of the disturbance of blood-volume in the creation of the associated symptom-complex of wound hemorrhage and shock will lead to important preventive measures, such as the insistence on a liberal intake of fluid by all methods during the times of the possible acquisition of wounds and immediately after wounds. Furthermore, in the treatment of all cases of warwounds insistence ought to be laid upon the liberal intake of fluids. Since Robertson and Bock have found in their cases studied, often several days or several weeks after wounds, that the blood-volume was frequently lowered, the insistence upon the liberal intake of fluid should be continued throughout convalescence. It is also common knowledge that external warmth is beneficial to cases of exhaustion, prostration and shock. It would seem to be of great importance, in view of these studies, to avoid very carefully any considerable amount of sweating in the application of external heat in order not to run the risk of reducing further the blood-volume. Experience shows that this consideration is often overlooked.

SUMMARY. The observations reported here would seem to indicate the importance of blood-volume in wound hemorrhage and shock. Profound disturbances of blood-volume are always serious,

and if maintained for any considerable period are usually associated with death. It seems evident that the human mechanism can tolerate greater changes in the oxygen-carrying constituent—that is, the hemoglobin—than in the blood-volume. This coincides with the well-known clinical observation that the result of hemorrhage results at first in a lowered hemoglobin, or, in other words, that the blood-volume is restored at the expense of dilution of the hemoglobin. Blood-volume can be easily and roughly estimated by comparative readings of the hemoglobin percentage before and after the intravenous infusion of a known amount of fluid. A knowledge of the blood-volume gives adequate data for the establishment of rational therapy.

The milder cases of wound hemorrhage and shock require only an increase in blood-volume. The severer cases require both an increase in blood-volume and an increase in oxygen-carrying constituent. This double requirement is met in part by transfusion. However, when transfusion is indicated it is usually desirable still further to increase the blood-volume, which may be accomplished in various ways.

The continued observations on blood-volume give, furthermore, valuable information as to prognosis.

A general study of blood-volume strongly suggests certain procedures which may be utilized for the prevention and control of the associated symptom-complex known as wound hemorrhage and shock.

There is reason to believe that the general observations have an application beyond the special field in which they were made. That the blood-volume may be seriously disturbed with its attendant indications for therapy in various conditions, which tend to derange the usual careful adjustment between fluid intake and outgo is certainly suggested.

I desire to record my appreciation of the work of Captain Baird, Captain Ohler and other officers of the Medical Corps of the A. E. F. who actually made many of the observations which are summarized here.

CYTOLOGICAL STUDIES OF PLEURAL EXUDATES COMPLICATING INFLUENZA.

BY BALDUIN LUCKE, M.D., DR.P.H., 1st LIEUT., M.C., U.S.A.,

PHILADELPHIA,

AND

RUTH BARKER, A.B., TECHNICIAN, U.S.A.

ST. LOUIS, MISSOURI.

(From the Cantonment Laboratory, Base Hospital, Camp Zachary Taylor, Ky.)

The exudate of influenzal pleurisy has certain characteristics which distinguish it from the inflammatory effusion complicating the pneumonitis primarily due to the pneumococcus, the streptococcus and other organisms. Thus, most observers lay stress on its thin, often hemorrhagic character and its low fibrin content. This is especially true in the early stages of the disease, the fluid becoming later frankly purulent and thick. Details as to the incidence and appearance of pleuritic involvement have been reported by one of us¹ in a general study on the pathological anatomy of influenza. Inasmuch as we were unable to find information in the literature concerning the cellular composition of the pleural exudate in influenza, the present study was undertaken on the pleural fluids of seventeen cases of influenzal pneumonitis occurring in previously healthy individuals. Clinically, these cases were of the usual type; all terminated fatally; the fluid was obtained at autopsy performed within a few hours after death. It was not possible to determine from the clinical records the duration of the pleural involvement. The total duration of the disease varied from four to thirty days, the majority of deaths occurring from the tenth to the sixteenth day. Grossly the exudate of the cases studied varied in amount from 50 c.c. to 3000 c.c.; it was generally thin, serosanguineous or seropurulent, but in several instances a definitely thick, pleural fluid was present. Cultures of the exudate and of the lungs were made in each instance. The smears were made in the ordinary way, dried in air and stained by Jenner's blood stain or separately by aqueous eosin and methylene blue, after fixation in Zenker's solution, employing the same method that is used for histological sections. It was found that better differentiation was obtained by this method.

SUMMARY OF RESULTS. The cells encountered were: Polymorphonuclear leukocytes, large and small lymphocytes and so-called transitional cells slightly larger than the leukocytes and having a single indented nucleus. Besides these there occurred

¹ Lucke, Balduin; Wight, Toynbee; Kime, Edwin: Pathological Anatomy and Bacteriology of Influenza (Epidemic of 1918), Arch. Int. Med., August, 1919.

Autopsy number.	Total duration of disease in days.	Character of pleural exudate.	Amount in c.c.	Bacteria.		Differential cell count of pleural exudates. (in per cent.)					Phagocytosis.
				In pleural exudate.	In lungs.	Poly-morpho-nuclears.	Small lympho-cytes.	Large lympho-cytes.	Endo-thelio-cytes.	Transi-tional.	
209	15	Fibrinopurulent	Small (r); 100 (l)	H.S.; Pnc.	Pnc.	29.3	1.6	4.0	60.1	5.0	Diplocc. seen twice in endothel., once in polys.
169	4	Serosanguinous	Slight (r)	Pnc.	Pnc. I; B. Inf.	16.5	2.5	6.3	72.0	2.5	None seen.
172	11	Thin seropurulent	220 (r)	B. Inf.; Pnc.	N.H.S.	23.6	5.0	1.4	68.0	2.0	Occasionally phag. of r. b. c. and of pne. by endothelialocytes.
202	13	Thick fibrinopurulent	100 (r)	H.S.; B. Inf.	H.S.; Pnc.	1.5	..	..	100.0	..	None.
188	16	Clear fluid	50	Pnc.	H.S.; Pnc.	..	..	..	98.5	..	Very occasional phag. of r. b. c. by endothelial.
228	30	Purulent	3000 (r)	H.S.	H.S.	78.6	0.6	2.6	16.9	1.3	None.
194	16	Sanguinopurulent, thin	1800 (r)	H.S.	N.H.S.	67.9	..	1.3	29.5	1.3	Much by polys.; very occasionally by endothelial of strep. and pne.
217	27	Yellowish, turbid, flaky	1000 (l)	H.S.	H.S.	76.3	..	8.5	13.3	1.9	Marked phag. of strep. and pne. by polys.
177	10	Thin, brown, purulent	500 (r)	H.S.; B. Inf.; Pnc.	Pnc.; H.S.	27.5	2.0	8.2	58.7	3.6	None.
184	12	Thin, slightly turbid, straw colored	200 (r; l)	H.S.	H.S.; B. Inf.	8.5	0.5	10.0	77.5	3.5	Marked phag. of strep. by endothelial, occasionally by polys.
214	13	Turbid, flaky	500 (l)	Pnc. II	H.S.	62.6	..	1.6	35.3	0.5	Occasional phag. of pne. by polys.
259	9	Turbid	250 (l)	N.H.S.	Pnc. III	52.8	1.0	2.0	44.2	..	None.
191	8	Thin, seropurulent	200 (r; l)	Pnc.	Pnc.	17.5	..	7.0	73.7	1.8	None.
190	16	Thin, purulent	100 (r; l)	Pnc.	Pnc.; H.S.	25.3	1.1	9.6	62.9	1.1	None.
170	14	Thin, greenish yellow	1500 (r)	Pnc.; H.S.	Contaminated	82.3	..	0.6	15.9	1.2	Occasional phag. of diplocc. by polys and endothelial.
187	14	Greenish, purulent	500 (r)	H.S.	H.S.; Pnc.	68.4	2.3	4.2	23.8	1.3	Marked phag. of diploc. by polys.
201	24	Thin, yellow purulent	1500 (r; l)	H.S.	Pnc.; N.H.S.; B. Inf.	89.9	0.7	2.2	6.8	0.4	Phag. of strep. by polys.

Abbreviations: Pnc., pneumococcus; H.S., hemolytic streptococcus; N.H.S., non-hemolytic streptococcus; B. Inf., Bacillus influenzae; r, right pleural cavity; l, left pleural cavity; R.B.C., red blood cells.

considerably larger, oval or round mononuclear cells measuring from ten to twenty microns and possessing a large, usually deep staining nucleus, with several prominent nucleoli and pale-staining cloudy protoplasm. These cells resemble in every way the endothelial cells described and pictured by Mallory,² Pepper³ and others. Their cytoplasm frequently shows numerous small vacuoles, probably evidences of degeneration. On the whole, however, they were less degenerated than the polynuclear cells, whose granules were often absent and whose nuclei and cytoplasm were frequently fragmented. Our results are summarized in Table I.

It is seen that in 10 of the 17 cases endothelial cells constituted over 40 per cent. of the total number. In 5 of these they even formed over 70 per cent. of the cells present. Large and small lymphocytes were never marked in amount, being present generally in less than 10 per cent. The polynuclear cells were low in percentage when the endothelial cells were high, and *vice versa*. Analysis in regard to the appearance and the cellular composition of the exudate and the duration of disease brings out that endothelial cells were most numerous in cases of short duration when presumably the pleural involvement was relatively recent and the fluid thin and serous. In cases of longer duration polynuclear cells predominated and the fluid was thick and purulent. Thus, in autopsy 188, where the pleural fluid was almost clear and straw colored, the endothelial cells numbered 98.5 per cent., while in autopsy 228 the fluid was frankly purulent and the cells chiefly polynuclears. Bacteriological analysis brought out no constant features. The organisms present in both the pleural fluid and the lungs were hemolytic and non-hemolytic streptococci, pneumococci and *Bacillus influenzae*. The type of the organisms apparently stood in no definite relation to the cellular composition of the fluid. This leads us to believe that the character of the exudate is primarily produced by the soluble virus of influenza and only secondarily influenced by the invading organisms.

Phagocytosis of bacteria was observed in nine of the fluids, the organism being pneumococci or streptococci. The phagocytic cells were chiefly polynuclears, but occasionally endothelial cells contained bacteria. Two of the fluids presented slight phagocytosis of erythrocytes by endothelial cells. In one instance there was a plaque of several endothelial cells apparently recently desquamated; these coherent cells showed no evidence of phagocytosis.

DISCUSSION. The importance of endothelial cells has been especially emphasized by Mallory. According to him they are called forth by mild injurious agents which act, for a considerable length of time, by agents which are mildly toxic or which act

² Principles of Pathological Histology, 1914.

³ Endothelial Phagocytes in Pleural Exudate Due to the *Bacillus Typhosus*, AM. JOUR. MED. SC., 1916, cli, 663.

mechanically only. Thus they form the chief or only cell reaction to the leprosy bacillus, the typhoid bacillus and usually to the tubercle bacillus and to certain protozoa (*Leishmania*). They are most prominent where the toxin is most concentrated. For example, in typhoid fever, one sees them especially in the mesenteric and intestinal lymph tissue, the spleen and the liver.

Pepper described endothelial phagocytes in typhoid pleurisy, reviewed the literature and stated that in all effusions due to organisms other than the typhoid or tubercle bacillus the endothelial cells play but a small part and are usually lost sight of in the great polynuclear reaction.

There are certain features which point to a similarity of the toxins of typhoid and of influenza in so far as the cellular reaction produced is concerned. In both diseases there is a distinct and persisting leukopenia and a proliferation of the lymphoid tissue and endothelial tissue, especially in regions where the toxins are most concentrated. Thus in typhoid fever the intestinal and mesenteric lymphoid structures are markedly enlarged; in influenza the peribronchial and peritracheal lymph nodes are highly swollen and histologically their sinuses are packed with endothelial cells. In both diseases we have enlargement of the liver and the spleen and toxic changes in these organs; in 126 influenza livers studied we found focal necrosis in about 50 per cent. It would seem then that *Bacillus influenzae*, or rather the as yet not determined virus of influenza, could be added to the list of organism or substances that produce an endothelial cell reaction.

CONCLUSIONS. Endothelial cells constitute the predominating type of cells in the exudate of influenzal pleurisies, especially in the early stages thereof; later, they become gradually replaced by polynuclear cells. These endothelial cells are slightly phagocytic for erythrocytes and occasionally engulf bacteria.

REVIEWS

ROENTGEN INTERPRETATION. A MANUAL FOR STUDENTS AND PRACTITIONERS. By GEORGE W. HOLMES, M.D., Roentgenologist to the Massachusetts General Hospital and Instructor in Roentgenology, Harvard Medical School, and HOWARD E. RUGGLES, M.D., Roentgenologist to the University of California Hospital and Clinical Professor of Roentgenology, University of California Medical School. Pp. 211; 159 illustrations; 20 tracings. Philadelphia and New York: Lea & Febiger, 1919.

THE first chapter deals with confusing shadows and artefacts, with an explanation of their most common sources and causes. The second chapter is a short discussion on anatomical variations and development, with a table taken from Rotch and Morris's *Anatomy*, giving the time of appearance of centers of ossification.

The following four chapters are devoted to bone and joint injuries and diseases of bursæ and tendons. Here a wide field has been covered very well, the descriptions being condensed without slighting any of the real essentials. At the end of the chapter on bone pathology there is a table for differential diagnosis. The differential diagnosis of bone diseases is, and probably always will be, one of the most perplexing problems for the roentgenologist, but still we think that the resemblance of carcinoma of bone to bone cyst is not striking enough to devote a differential table to these two conditions.

In Chapter VII the shadow of the chest is divided into (1) that of the thoracic wall; (2) a central shadow consisting of supraposed sternum, heart, great vessels, mediastinum and spine; (3) diaphragm; and (4) the lung fields. The high lights in the chapter are the parts devoted to the heart and lung fields. The former is illustrated with tracings and reproductions showing the points from which measurements are taken, the different dimensions of the average normal heart and the variations in the diameters in cardiac lesions.

The roentgenographic appearance of pulmonary lesions is clearly described, and it is refreshing to note that there is a tone of conservatism running through the discussion on tuberculosis.

The following chapter is devoted to the gastro-intestinal tract. There is little or nothing presented that is new, but the cardinal

points in examination technic are pointed out and the appearances of lesions described in a thorough manner. The book closes with the chapter on the genito-urinary tract. This chapter is of the same general excellence as the others and needs no further comment.

On the whole, Holmes and Ruggles have given the profession a well-illustrated manual that fulfils their hope that it would prove of practical aid to those in search of a working knowledge of roentgen interpretation. It ought to be valuable as a text-book for students and practitioners.

J. D. Z.

UROLOGY. By V. C. PEDERSEN, M.D., Visiting Urologist to St. Mark's Hospital, New York City. Pp. 948; 362 illustrations. Philadelphia and New York: Lea & Febiger, 1919.

THE author devotes 680 pages, or 70 per cent., of his new book on *Urology* to the subject of specific urethritis and such allied subjects as are essential to the diagnosis and treatment of the same. Gonorrheal infection, both in the male and in the female, is discussed from every possible point of view, and as a treatise on this one subject his volume is remarkably complete. He has adopted a different system from previous text-books of presenting his subject, discussing first the "pathology in general" of the various types of urethritis, then the symptomatology of these types and in subsequent pages the treatment, etc. To the post-graduate this method of presenting the differential points is good, but to the undergraduate student it is liable to be confusing, as one disease receives attention in scattered and distant portions of the book. Likewise, the method requires frequent reiteration and many references to other pages, and does not permit of ease of style, nor does it hold the attention. The chapters on urethroscopy and cystoscopy are excellent, copiously illustrated and outlining the methods of technic of a careful surgeon. Also the charts advocated for recording cases and the special findings at examination are much to be commended and too generally neglected.

In endeavoring to compile a text-book of Urology in one volume of less than 1000 pages the author has fallen into the error that such an effort inevitably entails, *i. e.*, incompleteness. One misses in the volume a more thorough exposition of the ever-broadening fields of the subject, for it must be remembered that the use of this word to express the scope of the specialty has been founded on the advancement, during the past two decades, of our knowledge in the fields of prostatic and renal surgery, the modern treatment of syphilis, functional diagnosis, cystoscopic operative procedures and the electric and radium treatment of vesical neoplasms. Each of these subjects receives but a cursory handling, oftentimes depending on a lengthy quotation from the original authority for

what should be the author's experience and opinion. One misses entirely a chapter dealing with the disease of the testis; hydrocele, varicocele and testicular tumors are apparently non-existent; the subject of syphilis is completely omitted; epispadias, hypospadias and other surgical abnormalities of the penis undescribed; diseases of the prostate (hypertrophy, contracture of the vesical neck, chronic prostatitis, tuberculosis, neoplasms and lithiasis) are crowded into a scant twenty-one pages at the extreme end of the book (while eighteen pages are elsewhere practically wasted on the subject of urinalysis), so that the impression is gained that the present-day exposition of the field of urology has been woefully misappreciated and neglected. As a treatise on urethritis the book is complete, its text is readable and remarkably free of grammatical or typographical errors. The general make-up of the book reflects credit upon the publishers.

A. R.

PULMONARY TUBERCULOSIS. By MAURICE FISHBERG, M.D., Clinical Professor of Medicine, New York University and Bellevue Hospital Medical School. Second edition. Pp. 744; 100 engravings and 25 plates. Philadelphia and New York: Lea & Febiger, 1919.

THIS edition has been largely rewritten, with the addition of new chapters on tuberculosis of the pleura and pneumothorax. All available literature upon the course and prognosis as learned by experience from our recent large army has been reviewed and all essential data incorporated. It is a practical and scientific book upon pulmonary tuberculosis, dealing with the disease from an etiological, diagnostic and treatment standpoint. A great deal of space is given to the importance of childhood infections; a sharp line is drawn between infection and disease or between tuberculosis and phthisis. Many statistics are given to bring forcibly before the reader the urgent need of the care of the child of tuberculous parents. The author believes that a small dose of infection received early in life immunizes the patient to further infection at a later period of life. He points out that before the age of three is the most dangerous time for the child.

Symptomatology of the disease is given its proper place, and to be sure it is the most important anchor to which the clinician can attach himself in determining the degree of activity and whether or not the patient needs extensive treatment. The symptoms are described in detail. The author brings forth that unless the patient be suffering with a toxemia in some form the patient cannot have an active process. The physical signs, their mechanism of production and clinical significance are described in detail with

their proper degree of importance. With a careful history and physical examination, almost all chest conditions can be rightly determined. Physical findings in the lungs without symptoms of a mild or severe toxemia do not indicate active pulmonary tuberculosis. Roentgenography is described as an aid to diagnosis, but is of no value in determining whether the patient is sick with tuberculosis.

The different types of the disease are considered, and especially those of childhood infection. Prophylaxis should be directed to the child, as adult infections are rare. A careful differential diagnosis between tuberculosis and such diseases as cardiac disease, bronchiectasis, pulmonary spirochetosis, influenza, hyperthyroidism, etc., is given. The influence of the recent epidemic of influenza upon tuberculosis is also considered, with a final conclusion that not a great deal of damage was done to the pulmonary invalid.

The chapters upon treatment are full and conclusive. Marked emphasis is put upon the home treatment of cases both before and after sanatorium care. The question is also treated from an economic view. Medicinal treatment as well as the use of artificial pneumothorax in selected cases is fully given. The book is undoubtedly one of the best upon the subject of pulmonary tuberculosis, and deserves a prominent place in the foreground.

T. E. D.

MORTALITY STATISTICS OF INSURED WAGE-EARNERS AND THEIR FAMILIES. The Experience of the Metropolitan Life Insurance Company, Industrial Department, 1911 to 1916, in the United States and Canada. By LOUIS I. DUBLIN, Statistician, with the collaboration of EDWIN W. KOPF, Assistant Statistician and GEORGE H. VAN BUREN, Supervisor, Statistical Bureau. Pp. 397. New York: Metropolitan Life Insurance Company, 1919.

THIS publication comprises statistics covering 635,449 deaths of persons more than one year of age occurring in the experience of the Metropolitan Life Insurance Company between 1911 and 1916 inclusive. Of this number 520,079 were of white persons and 115,370 deaths were of colored, or 82 per cent. were among white policy-holders and 18 per cent. among colored. The death-rate, however, among the colored was much higher because 87.5 per cent. of the exposed were white policy-holders. The data was collected from a geographical area much larger than that of the registration area of the United States, as several States not included in the latter are well represented in this data. It has been collected with the utmost care and many tables carefully compiled. These tables include number and percentage of deaths, by causes, by color, sex and age. All variations are explained in detail and

interesting comparison between the deaths in the registration area and those of the Metropolitan Life Insurance Company are made.

Special chapters are given over to such diseases as tuberculosis, cardiac diseases, kidney disease, pneumonia, malignancy, etc., tuberculosis being the greatest factor or cause of death of the wage-earner: 17.4 per cent. of all deaths were due to tuberculosis. Special attention is drawn to the fact that the mortality from this disease occurs at a time of life when there is still considerable expectation remaining to each individual and when death seriously disrupts family life. The long period of physical disability which usually precedes the fatal termination augments the economical loss.

Organic heart disease ranks second as a cause of death, comprising 11.9 per cent. of the total deaths, death occurring, however, in a greater proportion of cases in the aged.

Other chapters are given over to the diseases of childhood, including measles, scarlet fever, whooping-cough and diphtheria, diarrhea and enteritis and external causes of death (accident, suicide and homicide).

The supplement for 1917 shows a gradual decrease in the number of deaths from all causes notwithstanding there had been nine months of war.

The book is of extreme value to health and public-welfare workers, and should lend a great deal of encouragement to all interested in the care of the wage-earner and his family.

T. K.

GYNOPLASTIC TECHNOLOGY. By ARNOLD STURMDORF, M.D., Clinical Professor of Gynecology, New York Polyclinic Medical School. Pp. 334; 152 illustrations and 23 colored plates. Philadelphia: F. A. Davis Company, 1919.

UNDER the term gynoplastic technology the author describes several new plastic operations upon the female genital organs. In presenting these new methods of technic it is with the feeling that we have outgrown many of the older operations which have been passed on from generation to generation, although we have realized for some time that they did not satisfactorily fulfil their purpose. Most of the material in this book has appeared previously in the author's various contributions to current literature, so that the volume may be considered a collective review of the author's own work. Whether one accepts Sturmdorf's tenets and technic or not it is distinctly refreshing to the reviewer to read a book that is original and not merely the same old standardized text-book under a new authorship.

The introductory chapters deal mainly with preoperative prepa-

ration as followed by the author in his work, in the course of which he presents several valuable suggestions on matters that are frequently overlooked in preparing patients for operation. In a chapter devoted to sacral anesthesia many investigators are quoted, but in spite of their enthusiasm the author does not believe in the applicability of sacral anesthesia for plastic work at the present time. Chronic endocervicitis is considered in great detail and in the light of latter-day pathology, a great stress being laid on the futility of curettage as a therapeutic procedure in this condition. Among the other topics considered are perineal lacerations and their repair, fistulae of the various pelvic organs, cancer of the vulva and congenital malformations of the genital organs. The illustrations are very satisfactory in number and character, many colored plates enhancing this aspect of the book. Although this volume is chiefly of interest to the specialist, some parts of it could be read to great advantage by the physician in general practice.

F. B. B.

GERIATRICS: A TREATISE ON SENILE CONDITIONS, DISEASES OF ADVANCED LIFE AND CARE OF THE AGED. By MALFORD W. THEWLIS, M.D., Associate Editor, Medical Review of Reviews, New York City, with introductions by A. JACOBI, M.D., LL.D., and I. L. NASCHER, M.D. St. Louis: C. V. Mosby Company.

THIS is a very interesting book on the diseases and care of the aged, written by an author who has observed carefully and who pleads eloquently for a more thoughtful care of the aged than the medical profession has heretofore given. It is needless to say that it is a subject very worth while considering by all general practitioners and specialists.

Dr. Thewlis has covered the field from every angle, as his twenty-one chapters will testify. It is surprising, in a way, that medical care of the aged should differ in so many aspects from the care of younger adults. The chapter headings give some idea of lines along which these difficulties are pointed out. The important headings are as follows: The care of the aged, work for the aged, care of the eyes, senile mentality, diet, senile constipation, toxemia, blood-pressure, arteriosclerosis, nephritis, diabetes, prostatic hypertrophy, urosepsis, the checking of hemorrhage, secretions and excretions, malingering venereal diseases, sexual life and surgery of the aged. An interesting chapter on the value of old age encourages us in the hope that none of us need be afraid of getting old and that productiveness and power and influence need not be lost with advancing years.

Dr. Thewlis lays great stress repeatedly on the importance of not letting old people give up and of not permitting them to stay

in bed. There are other not so important repetitions in the text that appear to be unnecessary, and there is evidence that the proof could have been better read; but these minor criticisms can be lost sight of among the many excellent points of the book.

C. N. S.

CEREBROSPINAL FEVER. By C. WORSTER-DROUGHT, M.A., M.D., Capt. (Temp.), R.A.M.C., and ALEXANDER MILLS KENNEDY, M.D., Capt., Late R.A.M.C. Pp. 514; 64 illustrations. London: A. & C. Black, 1919.

THE authors of this excellent volume were fortunately placed for the study of cerebrospinal fever. One of the authors was a neurologist and the other a pathologist and bacteriologist, and their extensive experience in the army, combined with previous observations in civil life, was the inspiration for the monograph.

After some observations about the geographical distribution and seasonal prevalence and age, sex and race incidence, there is a chapter on the meningococcus and allied organisms. The authors apparently consider as allied organisms other members of the Gram-negative group of cocci. The dissemination of the disease and the predisposing causes follow, each claiming a chapter. After the incubation period and the mode of invasion have been discussed there is a long chapter on the symptoms. The different types of the disease are included in a special chapter. In considering complications, hydrocephalus seems to be of enough importance to have an entire chapter devoted to it. There are eleven other chapters, of which the more important are those on the cerebrospinal fluid, diagnosis, prognosis and treatment.

The illustrations are not remarkable. A quite complete bibliography is found at the back of the book. The authors are to be congratulated upon putting out so good a volume, the work on which was done during the stress and hurry of war.

A. G. M.

PROGRESS OF MEDICAL SCIENCE

MEDICINE

UNDER THE CHARGE OF

W. S. THAYER, M.D.,

PROFESSOR OF CLINICAL MEDICINE, JOHNS HOPKINS UNIVERSITY, BALTIMORE,
MARYLAND,

ROGER S. MORRIS, M.D.,

FREDERICK FORCHHEIMER PROFESSOR OF MEDICINE IN THE UNIVERSITY OF
CINCINNATI, CINCINNATI, OHIO,

AND

THOMAS ORDWAY, M.D.,

DEAN OF UNION UNIVERSITY (MEDICAL DEPARTMENT), ALBANY, N. Y.

On the Clinical Evidence of Involvement of the Suprarenal Glands in Influenza and Influenzal Pneumonia.—COWIE and BEAVEN (*Arch. Int. Med.*, 1919, xxiv, 78) were impressed by the fact that the most striking and most constant symptoms of influenza (asthenia, prostration and low blood-pressure) are also the cardinal symptoms of adrenal disfunction. Other symptoms common to acute suprarenal insufficiency and influenza are nausea, vomiting, epigastric and appendicular pains, pains in the back and tenderness on pressure over the back muscles. The question which arose was: Is there a causal relation between adrenal disfunction and the characteristic symptoms of influenza. The evidence on which the authors base their answer may be summarized as follows: Pathological: Of 70 necropsies on patients dead of influenza 6 showed hypoplasia and 1 atrophy of the adrenal bodies. Tests for suprarenal deficiency: Blood-pressure determinations were made on 25 members of the S. A. T. C. In the 20 uncomplicated cases the average systolic blood-pressure was 115 mm. Hg.; in the 5 pneumonias it was 99. These results are useful only in view of the ages of the patients (twenty to forty), for in typical adrenal insufficiency much lower blood-pressures are the rule. In suprarenal insufficiency, but not in health, there is a rise in blood-pressure after prolonged administration of epinephrin. In influenzal pneumonia a similar rise follows the intravenous injection of 10 mg. of adrenalin four times a day for three successive days. In one case the effect was quite marked, the blood-pressure rising from 119 to 131. In suprarenal insufficiency the

intramuscular injection of 1 mg. of epinephrin causes a rise in blood-pressure which may or may not be greater than in the normal individual, but which is always maintained for a longer period. In influenza, whether complicated by pneumonia or not the rise may be sustained for as long as seven hours instead of the normal one or two. Tests for endocrin disfunction: A common but not invariable feature of certain endocrin diseases is hypoglycemia. In influenza, complicated or uncomplicated, the blood sugar was always within the normal limits. In endocrin disfunction the intramuscular injection of 1 mg. of epinephrin causes a rise in blood sugar which persists for more than the normal hour or two. In influenza and influenzal pneumonia the increase in blood sugar may last for more than seven hours. In endocrin disturbances the ingestion of glucose, 1.75 gm. per kilo of body weight, causes an increase in blood sugar, which does not reach normal for three or four hours, while in normal individuals it returns in two hours. In influenza the blood sugar did not reach the normal within three hours, but did at the end of the fifth. There thus seems to be good evidence for the assumption that the asthenia, prostration and low blood-pressure of influenza and influenzal pneumonia are related to suprarenal disfunction. If such be the case the rational treatment of influenza is the administration of epinephrin. A series of cases received 10 or 15 minims of adrenalin intramuscularly every four hours four times a day. Almost invariably symptoms of epinephrin intoxication appeared—palpitation, nervousness, headache, increased lassitude, twitching, rise in temperature and increase in rate of pulse and breathing. The treatment was therefore abandoned and the conclusion reached that the intramuscular injection of epinephrin was of little, if any, benefit in influenza. According to the authors the explanation of the failure of treatment is to be sought not in the epinephrin *per se* but in the method of administration, and the problem which awaits solution is the discovery of the proper method of administering epinephrin.

The Uric Acid Content of the Blood Compared with the Renal Dietary Test.—BAUMANN and his collaborators (*Arch. Int. Med.*, 1919, xxiv, 70) report the results of 180 renal dietary tests and blood analyses made chiefly on patients suffering from arteriosclerosis and nephritis. During the dietary tests the patients were kept in bed and were given a uniform quantity of food and water. The Mosenthal modification of the Hedinger and Schleyer diet was generally used. The urine was collected in two-hour periods from 8 A.M. to 8 P.M. and in one period of from 8 P.M. to 8 A.M. The blood for analysis was taken before breakfast. One hundred cases with the clinical symptoms of renal involvement showed slight or moderate abnormality in the blood analysis and dietary tests. Sixty-six had an abnormality of the dietary test, while 74 per cent. showed an increased concentration of uric acid in the blood. The authors believe that the uric acid concentration is a delicate, if not the most delicate index of renal function at our disposal. It is certainly better than the urea test and is probably more delicate than the dietary test, which heretofore has been regarded as the most sensitive. A comparison of the results of the bland and low protein with the high protein and salt diet shows that with the bland, salt-poor diet the specific gravity of the night urine tends to be low and with the regular

diet the volume of the night urine is increased in those cases showing fixed specific gravity. It would appear, therefore, that these diets may be used interchangeably, but the bland diet has the advantage of being easily prepared and may be used if the protein diets are undesirable.

A Plea for the Early Administration of Atropin in Pneumonia.—STERLING (*New York Med. Jour.*, August 9, 1919, p. 237) concludes from his clinical experiments that all pneumonia patients should be atropinized from the moment they are first seen by the physician and that all influenza patients, in the present epidemic at least, should be treated as pneumonia patients. His advice may be summed up as give enough atropin and give it early.

Chronic Amebic Dysentery and Emetin-and-Bismuth Iodide.—The conclusions of CARLES (*Am. Jour. Clin. Med.*, July, 1919, p. 470) are as follows: (1) The hydrochloride of emetin, while marvellous in the treatment of acute amebic dysentery, has little influence in chronic amebiasis. (2) The remedy of choice in chronic amebiasis is the double iodide of emetin and bismuth. It is given for twelve days in doses of 0.18 gm. daily in divided doses. Its use is attended by the same dangers as those of emetin and calls for the same precautions. (3) In simple chronic amebiasis apparent cure is the rule; however, if the amebiasis is complicated by infection with trichomonas, tetramitus, and especially lamblia, a cure is the exception. The same is frequently true if there are present in the intestine large numbers of trichocephales, ascaris, etc. (4) In such cases the iodide of emetin and bismuth will have no effect unless the patients first are relieved of the parasites. This is simple except in the case of lamblia, the resistance of which to every known remedy is sometimes extreme. (5) It is always necessary to treat properly any coëxisting gastro-intestinal secretory insufficiency or any gastroneurosis or enteritis resulting from fermentation. To depend solely upon the specific treatment may result in failure or in uncertain cure. (6) Chronic dysentery being a chronic malady requires chronic treatment. In spite of the fact that recovery often appears to be complete the successive treatments with the double iodide of emetin and bismuth must be rigidly carried out as a matter of routine.

SURGERY

UNDER THE CHARGE OF

T. TURNER THOMAS, M.D.,

ASSOCIATE PROFESSOR OF APPLIED ANATOMY AND ASSOCIATE IN SURGERY IN THE
UNIVERSITY OF PENNSYLVANIA; SURGEON TO THE PHILADELPHIA GENERAL,
ST. AGNES AND NORTHEASTERN HOSPITALS.

Resection of the Cecum and Ascending Colon.—HORSLEY (*Annals of Surgery*, 1919, lxi, 25) says that when surgeons began to use the needle and thread for uniting intestine instead of mechanical appliances,

lateral anastomosis was much in vogue. Fifteen years ago, when this transition was occurring, probably the majority of all intestinal resections was followed by a lateral anastomosis, particularly if the colon was involved. At present the opposite is true, and even in the large bowel the end-to-end or axial union is becoming popular. Cannon and Murphy, after roentgen examination of animals in which end-to-end and lateral anastomosis had been done, found that there was not the "slightest evidence of stasis of the food in the region of the operation" with an end-to-end method. On the other hand, peristalsis was apparently abolished in the region of a lateral anastomosis, the fecal contents being pushed through the anastomosis only when a column of it extended into the unaffected proximal (oral) loop of bowel where peristalsis was unimpaired. The reasons for this are that the opening is not in the axis of the bowel, the severed circular fibers cannot act upon the bowel contents satisfactorily and there are two blind pouches in which the feces tend to collect. The proximal (oral) intestinal pouch is emptied with great difficulty. Lateral anastomosis is made in the direction of the long muscle of the bowel, and these external longitudinal fibers are split instead of being cut across as in the end-to-end method. Contraction of these fibers tends to close the opening in the bowel and a very long lateral anastomosis has to be made to prevent too much contraction. It requires much more bowel to make a lateral anastomosis than an end-to-end. The objection to the end-to-end method has been that it would leak at the mesenteric border. This is because infection here causes the sutures to give way. It can be avoided by dividing, clamping and tying this space and by clamping and tying the mesentery before opening the bowel. Horsley describes and illustrates a method of excising the cecum and ascending colon with end-to-end anastomosis and an attempt at restoration of the ileocecal valve.

Studies in the Standardization of the Wassermann Reaction.—BROWN and KOLMER (*Am. Jour. Syph.*, 1919, iii, 8) say that it is highly important to have all glassware used in the Wassermann reaction (pipette, test-tubes and flasks) chemically clean and free of all traces of acid or alkali by reason of the marked antilytic (anticomplementary) and hemolytic properties of these substances. Amounts of sodium hydroxide as low as 1 c.c. of a 1 to 400 dilution of a $\frac{N}{7}$ solution in 2 or 3 c.c. of fluid may be anticomplementary while 1 c.c. of a 1 to 100 proves hemolytic; approximately 1 c.c. of a 1 to 500 dilution of $\frac{N}{7}$ solution of hydrochloric acid is anticomplementary and 1 c.c. of a 1 to 300 dilution is hemolytic. Bichromate cleaning fluid proved anticomplementary in amounts as low as 1 c.c. of a 1 to 900 dilution and hemolytic in 1 c.c. of a 1 to 600 dilution. It is possible that minute traces of acid or alkali in the glassware may be responsible for falsely positive Wassermann reactions with normal serums, large amounts may produce negative Wassermann reactions with syphilitic serums, probably by reason of the direct hemolytic activity of mineral acids and alkalies in amounts greater than sufficient to destroy the complement. The use of one pipette for measuring different serums in conducting the Wassermann reaction introduces the possibility of carrying over sufficient syphilitic serum into a normal serum to produce an erroneous result

unless the pipette is washed between each serum. The use of a separate pipette for each serum is advisable. Test-tubes must be of a size suitable to the technic in order to avoid too high column of fluid in a narrow test-tube which tends to interfere with hemolysis. Physiological saline solution for the Wassermann reaction should be prepared of chemically pure sodium chloride in freshly distilled water in 0.7 to 0.9 per cent.; preferably 0.85 per cent. The kinds of test-tubes and pipettes advised for a standardized Wassermann technic and methods for cleaning and preparing them are described.

Criteria as to Cure in Syphilis.—LE COMTE (*Am. Jour. Syph.*, 1919, iii, 106) says that mercury has not been superseded by arsphenamin, and should be used in every case both early and after the more powerful spirocheticide has controlled the acute features of the infection. Fournier required three years' treatment with it; now, in view of the rapidity with which the lesions not affected by mercury alone can be cleared up by combined treatment and the promptness with which relapse can be detected, this period may safely be shortened. It may be held that a fair time would be six months after all symptoms have disappeared, guarding against relapse and resorting to arsphenamin when it occurs. The methods of administration will have to be varied with the peculiarities of the patient. Injections probably act more quickly and certainly, larger doses may be given safely by inunction, while the pain or inconvenience that these methods cause may make it necessary to treat some cases by oral administration. The choice of a salt can be suited by individual selection, the object being to administer as large doses as can be safely borne by the patient. The inference is that in every point except that of length of treatment, Fournier's rules for marriage must be followed; modern diagnosis and treatment gives advantages in detecting and controlling the disease at any time, that enable the physician of today to make concessions that he could not. Summarized criteria for cure today include treatment with arsphenamin and mercury until negative blood findings are secured and treatment with mercury for at least six months after this; observations for eighteen months after this with frequent negative blood examinations followed by negative spinal fluid findings. Any relapse should be considered as a reinfection so far as cure is concerned. Even with this it is scarcely possible to assure the patient that he is cured beyond all doubt; he should be informed of his chances of cure and told to report at yearly intervals, in the absence of symptoms, for further examination.

Cancer of the Tongue (Bradshaw Lecture).—POWER (*British Jour. Surg.*, 1919, vi, 336) says that cancer of the tongue has always existed in both men and in animals, the actual cause being as yet unknown. Its rapid increase among men within historical times is the result of two causes, predisposing and exciting. The predisposing cause is the degenerative change taking place as the result of spirochetel infection, the change being accentuated by the lapse of years and by indulgence in alcohol. The form in which the alcohol is taken does not seem to be important; beer, spirits and wine are equally harmful. It is the amount consumed and not the quality which matters. The exciting cause is local infection. The most effective local irritant is tobacco, although

pyorrhea and carious teeth often act as minor exciting causes. The exciting causes may act for a long time, but will not produce cancer, except in the rarest instances, without the long-continued action of the predisposing cause, syphilis. The occasional occurrence of cancer of the tongue in animals and non-syphilized people shows that, as in cancer generally, there is a *tertium quid* as yet undiscovered, which is called for convenience the predisposition to cancer. This predisposition manifests itself in the varying resistance to cancer shown by different persons. Sometimes the course of the disease is rapid and an accidental injury to the tongue is quickly followed by a carcinomatous ulcer; at other times, when every factor seems to be present and the individual ought to have cancer of the tongue, he lives to a good old age and dies of some wholly different disease.

A Study of Peripheral Nerve Injuries.—JOYCE (*British Jour. Surg.*, 1919, vi, 418) presents an extensive and careful study of 150 cases of war injured nerves. He has not seen any case of complete physiological division later than twelve months after injury in which the condition was not a complete anatomical section. On the other hand, many cases with palpable spindles on their nerves have been seen with full and complete recovery. Cone made a series of remarkable experiments, from which he concludes that war injured nerves are ready to unite at both ends of the injury before the end of eight months. Joyce's cases seem to confirm this. Joyce concludes that: In the majority of cases delayed end-to-end union of a divided nerve is successful, and this method of repair is that of choice. There is something to be said for reunion of nerve trunks by suture of bulbs. An appeal to results of cases so treated is the only way of settling this important matter. This is being done. The anatomical continuity of a nerve deserves the greatest respect. Exploration of a physiologically completely divided nerve should be done as soon as the condition of the wound permits. Neurolysis combined with capsulectomy of spindle-shaped neuromata has been followed by recovery in most, and improvement in all, cases in which this has been done. Exsection of a spindle-shaped neuroma is not justified unless failure has resulted from a neurolysis capsulectomy. Nerve transplantations and double lateral implantations of the ulnar into the median in the forearm have been followed with some measure of success, including some recovery of voluntary power in the affected muscles; but recovery is slow and uncertain. Nerve growth takes place from both ends of a divided nerve transplant, but axis-cylinders grow down only from the central end. An autogenous nerve transplant, of smaller size than the nerve into which it is planted, is capable of hypertrophy. Axis-cylinders, judged by Tinel's sign, grow at the average rate of 2 mm. per diem. Perineural scar tissue constricting young axis cylinders is the most important factor in hindering recovery.

An Unusual Type of Fracture-Dislocation of the Upper End of the Humerus.—DAVIES (*British Jour. Surg.*, 1919, vi, 466) reports the case of a Lance Corporal who was thrown from his horse. Roentgen-ray examination showed a subcoracoid dislocation of the head of the humerus, together with a spiral fracture passing downward and inward from the outer part of the head, ending on the inner aspect of the shaft

of the bone just above its center. Under a general anesthetic the dislocation was reduced. Then the fracture was reduced and the arm bandaged to the side of the body. No splint was used. The roentgen rays taken immediately afterward showed the fragments to be in good position and the dislocation satisfactorily reduced. A roentgen ray taken seven weeks after the accident showed union in good position, and the patient left the hospital a few days later with practically normal power of movement in the right shoulder.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Duodenal Stenosis.—CAUTLEY (*British Jour. Children's Dis.*, April-June, 1919) reports a case of a child who was brought to him for attacks of fever and vomiting. The first case in the literature was reported by Aubrey. Meckel quoted two instances. Schafer, Rokitansky and Guyot reported cases. Billard mentioned Schafer's case in his book. Hirschsprung reviewed 16 cases, Silverman 24, Gastner 16, Schegel 29, Cordes 57, Kulyer 46, Spriggs 92, Cowell 92. In all, including the case added by this author, about 100 cases have been reported. The most characteristic group of cases includes those in which the defect is in the neighborhood of the papilla of Vater, the point of entrance of the common bile-duct into the duodenum. In another group are placed those of the duodenal-jejunal junction. The first group may be subdivided according to the site of the defect, being above, opposite or below the papilla. Mere narrowing or an annular constriction partially or entirely obliterating the lumen is rare; also the presence of a complete or a perforated diaphragm, due to reduplication of the wall and consisting of the usual coats of the gut and not merely hypertrophied valvulae conniventes is rare. Usually there is an upper segment ending in a cul-de-sac and connected with a lower segment by a short band, a thread-like band or mesentery only. The latter is a rare type in which there is a complete interruption of the gut. In stenosis the intervening portions connecting the upper and the lower portions are of varying lengths and degrees of constriction. Atresia may be erroneously diagnosticated as stenosis because of an apparently direct communication between the two segments, the communication taking place indirectly by means of a branch of the duct which opens into the upper segment; a probe can be passed through this and the common duct into the lower segment. Vomiting, with the usual signs of obstruction, is the clinical picture. It may occur even if no food is given by mouth, the stomach becoming distended by normal secretions. Bilious vomiting occurs in about 90 per cent. of the cases if the obstruction is above the entrance of the common duct, and is probably due to an aberrant branch opening into

the dilated first part of the duodenum. Hematemesis is not uncommon. Naturally inanition, wasting and constipation are marked features. If food is taken and life is prolonged, as in some cases of stenosis, the stomach and first part of the duodenum become dilated and hypertrophied and there is a marked gastric peristalsis. The symptoms are practically the same as those of congenital hypertrophic stenosis of the pylorus unless bilious vomiting is also present. A dilated first part of the duodenum gives the sensation of a pyloric tumor, but it is neither so hard nor so well defined as in pyloric hypertrophy. It is perhaps needless to point out that no medical treatment is of real benefit and that possibly life may be saved in isolated cases by early surgical measures. In this case the above symptoms were present. Postmortem showed the stomach dilated and hypertrophied; the pylorus was widely dilated. The first part of the duodenum was widely dilated. The second part for a distance of an inch was extremely stenosed, admitting the passage of a probe, and the duct entered about the middle of the stenosed part.

Malnutrition in Children: A Study of the Examination of Nine Hundred Children under Eight Years of Age.—GORDON and BARTLEY (*Arch. Ped.*, May, 1919). In the examination of 900 children under the age of eight years for nutrition, as shown by appearance, weight and height, it was found that the weight to height basis was the most reliable standard of judging nutrition. Next in value was the weight to age relationship and then the general appearance. These figures show a higher rate of malnutrition than others that have been published for children in large cities. The explanation for this may be that the children of this series were practically referred, because it was thought that, due to their home surroundings and their physical condition, they were in need of a vacation away from their usual environment. The classification of the poorly nourished lessens considerably the incidence of those requiring urgent medical care and treatment. The most critical period of a child's early life is between the ages of two and six years. The chief causative factors of malnutrition in this series were environment and disease from the viewpoint of previous history and the condition at the time of the examination. A previous attack of measles, pertussis and pneumonia were found to have a deleterious effect in the order named, on the subsequent life of the child. Scarlet fever, diphtheria and the other contagious diseases apparently had little effect on the general health after recovery. Conditions present at the time of examination which can be considered as causes of malnutrition were adenoids and hypertrophied tonsils, defective teeth, gastrointestinal and heart lesions, in the order named. Nationality had some effect on nutrition. The degree of nutrition present in a child should not be judged by one standard alone, but by a comparison of two or more.

The Organization and Methods of Contagious Disease Service.—STOKES (*Penna. State Medical Jour.*, August, 1919) discusses at length this problem as developed in the planning of this type of hospital. In the management of the ideal institution the following rules were evolved from the methods of a number of the best contagious hospitals in this country: "(1) Attendants should change from street to short-

sleeved duty uniform on entering the hospital and make a reverse on leaving. (2) The infection should be limited to the quarters containing the patient. (3) The aseptic character of all corridors and passageways should be rigorously maintained. (4) Areas and objects as follows should be regarded as invariably infected: (a) the floor; (b) the patient; (c) all parts of the patient's room within reaching distance of his bed and in fact, in many hospitals, the entire room as high as a person can reach; (d) everything with which the patient or the above-mentioned objects come in contact. This includes bedding, utensils, food, discharges from the patient, etc. (5) A special gown covering the entire costume should be worn by attendants while they are within the infected area. (6) This gown should be removed, properly handled and disposed of in accordance with an exact technic before the attendant enters a clean area. (7) A cap covering the hair should be worn. (8) A face mask should be worn by persons while on duty in an infected area, especially while attending certain types of cases. (9) All attendants should rigorously cleanse the hands and forearms with soap and brush and running water before they leave the infected area. (10) Any article that has touched one of the above mentioned infected objects should be immediately treated as infected. (11) Every infected object should be efficiently sterilized as follows: Dishes should be boiled, garbage burned, dressings and infectious discharges on rags, etc., burned. Gowns, linens, and clothing should be sterilized either by immersion in sterilizing solution followed by steam laundrying, or by steam sterilization with or without subsequent laundrying. The body should be cleansed by washing with soap and water; little reliance is placed on disinfectants. When the patient is discharged mattresses and unwashable clothing and bedding should be sterilized by steam or formaldehyde in special steam sterilizers or rooms and subsequently exposed to air and sunlight. The bed should be washed with lysol and water, and exposed to air and sunlight. The room should be scrubbed (the floors and walls as high as can be reached) with soap and hot water. Radiators, chairs, tables, doors, door frames, door knobs, etc., should be included in this scrubbing. Fresh air and sunlight should be used in every possible way for the control of the infection. (12) The patient should be discharged in such a way as will prevent his infecting the corridors through which he is taken, or his carrying infectious material to the outside. (13) Every patient should be treated individually in a single room rather than collectively in wards. (14) Rooms containing a single type of disease should be grouped in one unit, under a single nurse or a group of nurses who do not care for any other type of disease, even though using an aseptic technic. (15) The privileges of visitors should be restricted. (16) Where patients are kept together in wards, even with the same disease, the beds should be separated by sheet curtains or by glass cubicle partitions. (17) Crowding either by having too many patients to the room or unit, or too many patients for each nurse should be absolutely prohibited. Crowding spells the complete breakdown of any system of contagious technic and subsequent cross-infection. (18) Every entering patient should be detained in "solitary" until the longest period of incubation of a contagious disease is passed (three weeks) before he is placed in any ward or in contact with any other person. This is to prevent crosses from patients incubating one disease

while entering with another. (19) Cultures from the nose and throat should be obtained from all persons entering the hospital as patients or staff, for the detection of carriers; the culture should be repeated on discharge. (20) All female infants should be examined for vaginitis (vaginal smear), and the inevitable rule made never to place two female infants in the same room or to allow diapers, etc., to be washed by floor nurses."

Fat Metabolism of Infants and Young Children: III—Fat in the Stools of Children on a Mixed Diet.—HOLT, COURTNEY and FALES (*Am. Jour. Dis. Children*, August, 1919) continue their studies on fat metabolism. This study presents observations on children whose diet contained a large proportion of mixed foods and gives the findings as to fat percentage and distribution in the stools of a number of children receiving a mixed diet and the fat retention of these children. The material examined consisted of 134 collections of the feces of 62 children from one to ten years of age. In the normal or constipated stools of older children whose diet consisted of milk alone or milk with bread and cereal the fat percentage of dried weight averaged 30.7, which is lower than the average found for similar stools of infants taking modifications of cow's milk. The soap percentage of total fat averaged 60.9, which was somewhat lower than that found in the stools of the infants. The normal and constipated stools of children on a mixed diet showed almost identical average values both for fat percentages of dried weights and for distribution of fat. The fat percentage of dried weight averaged 18.0 and 20.1, and the soap averaged, 45.1 and 47.9 per cent. of the total fat. These values were much lower than those found when the diet contained little or no solid food. In the acid abnormal stools of children on a mixed diet the fat averaged 15.1 of the dried weight. Both the fat percentage of dried weight and the soap percentage of total fat were much lower than in normal stools and the values for fatty acids and for neutral fat were higher. With rachitic children the fat percentage of dried weight averaged 34.7 in the alkaline stools and 24.6 in the acid stools. The values were higher than those found for corresponding types of stools for normal children. The proportions of soap, fatty acids and neutral fats were not significantly different from those of normal children. The stools of children suffering from chronic intestinal indigestion showed a much higher fat percentage of dried weight than those of normal children. The average for alkaline stools was 36.4 per cent. and for acid stools 35.3 per cent. The average percentage of neutral fat was lower in both alkaline and acid stools of those children than in the stools of normal children. The fatty acids were higher than normal, and much higher when the stools were acid. The average fat loss in the stools of normal children varied between 2.6 and 3.0 gm. in all the groups studied, being highest in the stools of children whose diet contained the smallest proportion of solid food and the largest proportion of milk. The normal children on mixed diet retained on the average about 94 per cent. of the fat intake, regardless of the type of stool. The average actual retention was about 38 gm. daily. The children with little or no solid food and a smaller fat intake showed a lower actual and a somewhat higher percentage retention than those on a general mixed diet. The rachitic children showed a slightly

larger fat loss in the stools than the normal children. Their intake was higher. The actual retention equalled or exceeded that of the normal children, and their percentage retention was only a little lower than the normal average. The fat loss in the stools of the children suffering from chronic intestinal indigestion was very great, averaging 7.3 gm. daily in the alkaline stools, and 8.0 in the acid stools. Both the actual and the percentage retention were much lower than normal. The percentage of the intake retained averaged 79.1 when the stools were alkaline and 77.7 when they were acid. When the intake of fat was very high the actual retention was usually as high as that found in normal children.

The Constipating Qualities of Orange-juice.—GERSTENBERGER and CHAMPION (*Am. Jour. Dis. Children*, August, 1919) report observations made on a normal infant of ten months. This was done to ascertain the relative value as a cathartic or laxative of orange-juice to an equal amount of a 10 per cent. sugar solution composed of 6.5 per cent. glucose and 3.5 per cent. sucrose. In one period no difference was shown in the two solutions. In the other period a relative laxative advantage of the sugar solution over the orange-juice, or better, a relative constipating ability of orange-juice as compared with the effect of the 10 per cent. sugar solution was shown. During the sugar solution period anywhere from 95.71 to 96.53 per cent. of the water output went by the way of the kidneys, and from 4.29 to 3.47 per cent. of the water output went through the intestines, while in the case of the orange-juice from 97.15 to 97.25 per cent. of the fluid output went by the way of the kidneys, and from 2.85 to 2.74 per cent. by way of the intestines. In other words, orange-juice, relatively speaking, has been less laxative than a 10 per cent. sugar solution when given in doses of 15 c.c. six times in twenty-four hours. This observation confirms the authors' practical experience that orange-juice in the maximum amounts ordinarily used has more of a constipating effect than a laxative one, and they think that it should be used only as an antiscorbutic or as a diuretic and not as a laxative, and especially not in children who are already constipated. These observations also point to the important role that diuresis may play in the production of constipation, and it may be possible that some of the cases of constipation in infants supposed to be due to abnormally long retention of feces in the gut, and a consequent too complete absorption of water in the large intestine are primarily due to a factor that causes an abnormal increase of excretion of water through the kidneys.

The Shick Reaction and Its Practical Application.—PARK (*Arch. Ped.*, May, 1919). The results of embodied clinical and laboratory experience in testing the blood for antitoxin in cases of diphtheria and in persons in contact with diphtheria who have no antitoxin or only a minute amount in the blood and tissues show the value of this examination. The methods previously in use for the estimating of antitoxin, and thus separating susceptible from non-susceptible individuals, have been too troublesome and time consuming to be of practical value in routine cases. Shick in 1913, published the description of a simple clinical test, by which this can be accurately accomplished. The action

depends on the local irritant of minute quantities of diphtheria toxin when injected intracutaneously. If antitoxin is absent, or present only in small amounts, insufficient for protection from diphtheria a positive reaction will appear in from twenty-four to forty-eight hours. The amount of toxin injected, as advised by Shick, is $\frac{1}{30}$ minimum lethal dose for the guinea-pig in 0.1 c.c. of normal saline solution. The author prefers $\frac{1}{30}$ minimum lethal dose in 0.2 c.c. of normal saline solution. It is necessary to give it intracutaneously so that the toxin will remain in the dense tissue and have time to exert its irritant action. The Shick reaction has been carried out for the last five years on all patients admitted to the scarlet fever pavilion of the Willard Parker Hospital. Only cases giving positive reaction were immunized against diphtheria; those giving a negative reaction were given no immunization, but were carefully observed. Though many of these became carriers of virulent diphtheria bacilli, no cases of clinical diphtheria developed. Those reacting to the test received injections of diphtheria antitoxin. It was found that the greatest susceptibility to diphtheria was between the first and fourth years. Toxin-antitoxin used as a vaccine has proved to be as effective an immunizing agent as typhoid vaccine. It is absolutely harmless. No reaction develops in infants while in older children and adults a moderate swelling of the arm may appear and lasts for one to three days. One injection gives immunity to 80 per cent. of those previously susceptible. Two injections give immunity to 90 per cent. and three injections to 97 per cent. Immunity conferred lasts for at least three years and probably much longer.

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

The Injection of Fluid into the Placenta to Aid in the Separation.—FREY-BOLLI (*Jour. Correspondenz-Blatt, f. schweizer Aerzte*, April 19, 1919) has injected fluid into the placenta through the umbilical vein to make the placenta larger and heavier. To facilitate its separation, the fluid irrigates the wall of the uterus, causing it to contract and increasing its action in separating the placenta. The maternal stump of the cord should be wrapped in sterile gauze, as soon as it is divided, to maintain the sepsis, should it be necessary to inject fluid later. In 3201 deliveries, there were 53 cases of the retention of the placenta with hemorrhage. After injecting fluid, the placenta was spontaneously discharged in 46 per cent., and with like pressure in 41.5 per cent. In 7.5 per cent. placenta was expelled under general anesthesia, and in only 2 cases, 3.7 per cent., was manual delivery of the placenta required. The earlier the fluid is injected, the better, before the uterine muscle becomes exhausted. From 300 to 500 c.c. of saline and boiled water is used. If this produces no result, it is allowed to run out, and the same amount is again injected and, by repeating the proceeding, success follows.

Retention of Urea in Kidney Disease.—SCHELL (*Norwegian Jour. Med.*, April, 1919), in 25 cases of acute nephritis, observed recovery or material improvement. There was retention of the urea in both the blood and the spinal fluid, but it never exceeded 1.94 per thousand, and usually grew less. In 19 cases, the urea was over 2 per thousand, and these all had an unfavorable termination in a short time. When the urea rose to over 4 per thousand, death occurred in a few days. One must not be misled by a low urea percentage; for, when this reaches 1 per thousand, a fatal result may follow. There is no relation between the reduction of urea and dropsy. On the contrary, the greater the urea retained, the higher is the blood-pressure; but these phenomena are independent of each other and may occur separately. When headache, lack of appetite and vomiting are unfavorable symptoms in these cases, they are less important than the reduction of the urea. These studies throw some light upon eclampsia and lead us to recognize the fact that this may occur with or without uremia. In the toxemia of pregnancy, the percentage of urea in the blood is a valuable indication of the gravity of the case.

The Continued High Maternal Mortality of Childbirth.—BONNEY (*Lancet*, May 10, 1919) believes that it will be impossible to establish large lying-in hospitals, maintained by public funds, either national or municipal, until the public has been made to understand that labor itself is a surgical operation. Such hospitals should contain free beds and, in addition, paying wards and separate rooms for those who can afford them. Obstetrical teaching will, naturally, be done at these hospitals, and students should live in them for at least three months. Out-patient obstetrical service, as conducted at present, should be abolished. This perpetuates all that is bad concerning obstetrics, at the present day. When a student is obliged to conduct cases of labor in these surroundings, he comes to believe that the hospital practice is theoretical and not intended for general use. Patients taking private rooms should be attended by their own physician, and should pay him adequate fee. He should have the services of the residents, as required. The writer of the article quoted has stated clearly some of the most important elements which prevent improvement in obstetrical practice. His statement that out-patient practice is objectionable would be denied by many, but it is, nevertheless, true. No other department of medicine would think of teaching students in this manner or to subjecting its patients to such unfavorable conditions.

The Transmission of Malaria through the Placenta.—GENTILI (*Jour. Amali di Ostetricia*, Nos. 3 and 4, 1919) contributes an extensive paper on this subject, with a report of 29 collected cases, and adds one case resulting fatally, in which autopsy on mother and child was obtained. In the mother, the autopsy showed irritation of the meninges and congestion of the cerebellum; hypostatic congestion of the bases of the lungs; fluid in the pericardium, the heart muscle flaccid; the endocardium and valves normal, involvement of the lining membranes of the aorta; the kidney distended and the capsule not separating easily; the spleen swollen, its pulp dark red in color, while the organs of special sense in the body seemed not to have been disturbed. The

uterus was seven months pregnant and the fetal sac unbroken, and the child not macerated. The essential features in the autopsy in the mother intersticed of nephritis and acutely infected spleen, beginning atherosclerosis of the aorta, congestion of the right lung and congestion of the membrane of the brain. The blood was altered and masses of coloring matter had escaped from the vessels. Autopsy on the child showed changes in the blood, although the greater portion of the fetal organs were healthy. The placenta, membranes and cord showed granules of blood pigment deposited in masses in the placenta. The feature was one of blood infection, plainly traceable through the placenta.

Tuberculosis of Pregnancy.—FUNK (*Med. Clinics of North America*, 1918, No. 2, p. 803) discusses the general subject of tuberculosis complicating pregnancy and adds five case reports. Among 200 married women with pulmonary tuberculosis, 30 per cent. stated that the first signs of their disease became apparent during or following pregnancy. It seems most likely that many of these patients have tuberculous lesions which were not active before pregnancy. Among women of child-bearing age, tuberculosis is very fatal. This results largely from the fact that pregnancy and parturition lower the patient's vitality and spread new foci of infection by the violent respiratory movements made during vomiting or during labor. Sterility is rare among patients with pulmonary tuberculosis. Conception may occur, even when the disease is far advanced. Among 100 patients having tuberculosis 18.8 per cent. had miscarriages. In view of these facts, tuberculous women should be advised against marriage and conception, unless the lesion has been cured. The only test for this would be the fact that the patient had remained well for two or three years under the ordinary conditions of life. When tuberculosis is active and in the early stages, if conception occurs, pregnancy should be terminated before one and one-half months. Before making diagnosis, the patient should be kept in bed and examined several times by a specialist, and, if it is found that the tuberculosis process is progressing, an obstetrician should be asked to empty the uterus, with as little disturbance as possible. For anesthesia ether should not be used. When the tuberculous lesion is in its first stage, and the process is not active, if the best hygiene can be secured, the pregnancy may be carried on. If, however, at any time the tuberculosis becomes active, the indication is for radical treatment. If the tuberculosis is active and in the early stages, while the pregnancy is in the latter part, it is permissible to carry the patient on as near the natural termination of pregnancy as possible. Where the tuberculous process is very far advanced, no interference should be used. Unless the mother's tuberculosis has developed very greatly, the children born are frequently healthy. It is rare to find congenital tuberculosis. Tuberculous mothers should not nurse their children, and care should be taken not to infect the child from the mother's hands or through the discharges from the mouth. This precaution is of very great importance.

Postpartum Shock.—BERMEUN (*Argentine Review of Obst. and Gynec.*, 1918, No. 2, p. 417) reports the case of a primipara in whom labor lasted sixteen and one-half hours, the second stage four hours. The

child weighed 3000 grams. The placenta remained in the vagina, the membranes adherent to the uterus. The patient had pronounced shock, which was made worse by efforts to remove the placenta. The placenta was rapidly delivered, but there was no hemorrhage, the blood ducts being only about 500 drams, and the patient rapidly recovered under stimulation. The symptoms were thought to be of acute anemia, but, as the patient had no hemorrhage, this could not have been present. Shock during or immediately after labor, in poorly developed primiparae is not infrequently observed, and may be without apparent cause.

Abdominal and Vaginal Section in Cases Complicated with Infection.

—D'ERCHIA (*Annali di Ostetricia e Ginecologia*, 1919, Nos. 5 and 6) contributes a paper upon this subject and reports the case of a patient in labor with prolapsed arm and uterus slightly contracted. The amniotic liquid had been completely discharged and there was a putrid, and discolored, vaginal discharge. The temperature was much elevated, the pulse 120. Methods of dilating the cervix failed and the patient's condition was such that no violent efforts at dilatation could be endured. A typical Porro operation was performed successfully. A second primipara, above the average in age, was admitted, having a rachitic pelvis. The fetus was dead and there were evidences of infection. In this case, also, a Porro operation was successfully done.

The Problem of the Cystocele.—WARD (*Am. Jour. Obst.*, May, 1919) contributes a paper giving the results of his experience during eleven years of operative work. He believes that cystocele is the composite result of several injuries. A method of treatment by operation should aim to correct all the lesions so that there should be no weak spot. The bladder must be mobilized and elevated and the excess bladder drainage must be disposed of with the increased anteroposterior length of the vaginal wall. The operation must also restore the normal attachment of the vagina to the cervix, for the severing of this attachment is one of the principal causes of prolapse. So also the uteropubic ligaments and the vaginal wall just above the pivot point must receive attention. The lesions which bring about cystocele occur in parturition and hence obstetricians are interested in any paper bearing upon these phenomena.

A Method of Demonstrating with the Hands the Mechanism of Labor and the Various Types of Pelves.—MORAN (*Am. Jour. Obst.*, June, 1919) contributes an illustrated paper showing his use of the hands in various postures to illustrate some of the essential facts in obstetrics. The hand closed as a fist has several diameters which may illustrate relatively those of the pelvis. In various positions the true conjugate can be illustrated or the hands combined may be employed to illustrate the mechanism of labor.

Reconstruction of the Uterus.—ROBINS (*Surg., Gynec. and Obst.*, May, 1919) reports two cases in which patients had suffered with indefinite symptoms, suggesting the presence of a fibroid tumor. At operation, a small fibroid was found at the fundus, in one case chronic appendicitis, while both patients had the endometrium greatly thickened and diseased. The operation consisted of excising the fibroid, curetting

the uterus through the incision and bringing the tissues together. One patient had two abortions following the operation; but, five years later, gave birth to a healthy child. The second patient remained unmarried. The purpose of the operator in these cases was to retain the uterus and to remove the pathological condition which was evidently causing, or might cause, sterility.

An Analysis of 304 Cases of Ectopic Gestation.—FARRAR (*Am. Jour. Obst.*, June, 1919) has studied 309 cases of ectopic gestation treated in the Woman's Hospital of the State of New York. As regards the cause of this condition there is reason to believe that infection or mechanical alteration due to adhesions of the fallopian tube predispose to ectopic pregnancy. The most usual time for the development of symptoms, especially acute, is when the period is expected or just after the normal period. Unless an ectopic pregnancy has ruptured there is always pain either with or without bleeding. This pain is more calm like and bearing down than tearing or lancinating. When the patient has unusual one-sided pelvic pain with evidence of irritation of the peritoneum and attacks of fainting a diagnosis of ectopic pregnancy is strongly suggested. Every case demands operation in a hospital so soon as possible and if the patient is in a serious condition no minute examination should be made until the hospital is reached. Unless the other tube is evidently diseased it should not be removed.

Cesarean Section under Unusual Conditions.—CONAWAY (*British Jour. Obst.*, June, 1919) reports the case of a primipara forty-one and a half years old, admitted to the hospital at full term pregnancy, suffering from peritonitis. There was slight albuminuria and a two plus Wassermann reaction. The abdomen was enlarged and flattened, the pelvis slightly contracted. Pains had begun twenty-four hours before admission, with little progress. The cervix was so rigid that under anesthesia not more than three fingers dilatation could be secured. After forty-eight hours of irregular uterine contractions with no progress, section was performed. The uterus was adherent to the peritoneum on the right side, the mesentery adherent to the fundus. There were twin children, one of whom was cyanosed and resuscitated with difficulty. The source of the peritonitis was found in the appendix, which was postcecal and embedded in an inflammatory mass. There was no abnormal condition of the tubes or ovaries. The fallopian tubes were tied with double ligatures as the patient's condition was so grave that haste was imperative. The patient had a complicated convalescence, with chills, excessive sweats and bad heart action and failure of the intestines to act for four days. Pus formed and gravitated to a cul-de-sac whence it was removed by puncture and drainage. The mother finally made a good recovery and the children did fairly well. A second case was that of a negro primipara, pregnant at term, with incomplete intestinal obstruction. The usual methods of emptying the bowels failed. It was necessary to perform section and the child was delivered by section. The obstruction to the bowel was caused by a large inflammatory mass on the right side. This contained the appendix very much enlarged and adherent, a large pyosalpinx and a diseased ovary. The left tube and ovary were normal. There was no gangrene and no free pus. The patient had a difficult convalescence and acute peritoneal inflammation

continued about a week. The lower part of the abdominal wound became infected and there was much difficulty in keeping the bowels open. The second week after operation the peritonitis subsided, the wound closed rapidly, the uterus contracted well and mother and child made a good recovery. Another negro primipara was brought to the hospital pregnant at term, having had pains during the preceding night. On examination the cervix admitted two fingers and a foot was presenting. The pelvis was slightly smaller than normal. Pains continued until the body of the child was delivered when the head failed to rotate and remained transversely across the superior strait. On consultation it was decided that decapitation and craniectomy were indicated. Accordingly the placenta and a very large head were immediately removed through a median incision in the fundus. The gauze drain was left in the uterus and the patient made a remarkably good convalescence. In the fourth case, a primipara, suffering with ectopic convulsions, albuminuric retinitis was so far advanced as to cause total blindness. There was general edema of all the muscles. Only 4 ounces of urine had been obtained by catheter in twelve hours and this showed a high percentage of albumin, and casts. The patient was delivered by section and a living child easily removed. To prevent future conception both tubes were removed. The mother made a fairly good recovery and the child survived.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA,

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Coexistent Disease of the Appendix and Pelvic Organs.—All surgeons who have had much experience with pelvic disease in the female will agree that disease of the appendix is often associated with disease of the female generative organs. This combination is so commonly seen that we seldom stop to consider in which organ the involvement was primary because it makes little difference so far as treatment is concerned in the average cases. An analytical study of this study has been made by CHILD (*Am. Jour. Obst.*, 1919, lxxx, 31) in a large series of cases and he states that where the primary infection is in the appendix it is unusual to observe any very extensive pathological changes in the pelvic organs. A few restricting adhesions that, aside from the subjective symptoms they may cause by restricting the mobility of these organs, are of little moment, seldom if ever causing permanent tissue change to be observed. An exception to this may, however, be taken when the appendix is in the pelvis and suppurative, for in such cases it is not unusual for the pus to gain access to the tube through the fimbriated opening, or to the ovary through the site of a recently

ruptured Graafian follicle, and cause extensive adnexal destruction. When the primary infection is in the adnexa, the secondary involvement of the appendix becomes a much more serious matter, for here extensive pathological changes often take place that later break out into an acute attack menacing the life of the patient if the appendix is allowed to remain. The interference with nutrition alone to a slightly involved appendix resultant on the removal of the right appendages may be sufficient to cause a rapid degeneration in that organ. In the 746 cases of this series, the appendix was removed 339 times. It was pathological 244 times, giving a percentage of 32.57 for the whole series. This percentage was much higher in the inflammatory conditions of the adnexa, where it averaged 46.70 per cent. In the cases where the inflammatory affection of the adnexa was limited to the right side, the percentage of involvement of the appendix was 66.66, while in those where it was on the left side only the appendix involvement drops to 18.42 per cent. The appendix was found in the pelvis adherent to diseased right adnexa in 75 cases. Of these 25 showed acute inflammatory changes while 37 were either subacute or chronic. Gas distention of the appendix was encountered three times. Only once was the appendix or any part of it found to the left of the mid-abdominal line, and in this case, a very long appendix measuring over five inches in length, was drawn well over into the left abdominal quadrant where it was adherent to the sigmoid. As a result of this study Child concludes that disease of the pelvic organs in the female is an important exciting cause of appendicitis, and to a lesser extent the appendix may be a cause of right adnexal disease, but in by far the greater number of cases of coëxistent pelvic disease and appendicitis, the primary source of infection is in the pelvis. Involvement of the appendix is nearly four times more frequent in right adnexal disease than in left and as the possibility of an involved appendix should always be borne in mind when operating upon diseased adnexa, so also should the possibility of diseased adnexa be borne in mind when operating on the appendix.

Chronic Endometritis.—Chronic endometritis is an inflammatory process in the stroma of the endometrium characterized chiefly by a more or less marked infiltration of small round cells, with or without the presence of plasma cells. Formerly the term "chronic endometritis" was applied in a rather indefinite manner to numerous lesions of the endometrium, many of which were not of an inflammatory nature. The investigations of Hitschman and Adler in 1907, which have been universally accepted, showed that many of the so-called cases of chronic endometritis were in reality cases in which the endometrium was normal and the changes in structure that had been noted were merely the physiologic changes which occur as a result of the menstrual function. Following this study, it became a fairly general opinion that chronic endometritis was a comparatively infrequent condition. This opinion is now questioned by SCHWARTZ and KOHLBRY (*Jour. Missouri State Med. Assn.*, 1919, xvi, 209), who state that during the course of two and one-half years in the examination of curettings in the routine manner, it was very surprising to note the unusual frequency with which the diagnosis of chronic interstitial endometritis was being made. They felt that perhaps they had been too free with the diagnosis of chronic

inflammation and thought it would be interesting to study these cases as a whole in order to confirm or modify their previous findings. Their belief is that in order to make a diagnosis of chronic inflammation, it is necessary to find small round cells, if alone, in considerable quantity. These must infiltrate the upper half of the endometrium either in a diffuse manner or appear in small groups. They should also be found, when they are present in any great number, grouped around the glands, both superficial and deep. In their study of 305 specimens of endometrium, they were able to diagnosticate chronic interstitial endometritis in 70 cases which were divided into classes according to the menstrual phase to which they belonged. This placed 16 specimens in the early premenstrual phase and none in the later period. There was 1 menstruating uterus. Postmenstrual mucosæ were found fifteen times, seven early and eight late. Thirty-seven specimens were found in the interval, eighteen in the early interval and nineteen in the late interval. The glands were pathological in twelve instances, the diagnosis of gland hypertrophy being made five times, and gland hyperplasia seven times. There was one senile endometrium and in two cases there was tuberculosis. Small round cells were found alone twenty-four times, with plasma cells forty-one times, and with polynuclear leukocytes five times. As a result of their study they feel that chronic interstitial endometritis is rather frequently met with and also that the presence of small round cells alone in marked numbers, as was the case in twenty-four instances in this series, is sufficient evidence on which to base a diagnosis of chronic interstitial endometritis.

Radium in Genital Cancer.—It has been several years since we have had any reliable statistics on radium therapy from Germany and therefore the report and conclusions of BUMM (*Zentralblatt f. Gyn.*, 1919, i, 1), who is the professor at the University of Berlin, are of interest. Between the years 1913 and 1915 he subjected 401 cases of genital carcinoma to radiation with mesothorium or radium and in the three to six years that have since elapsed he has had ample opportunity to study the end-result. Before presenting his views on the subject it is worth while to review the accompanying tables that he has presented. The operative mortality in cancer of the cervix when the radical operation was employed in 203 cases in the author's clinic from 1911 to 1915 was 13.8 per cent. Of 157 cases operated upon between 1911 and 1913, 77 were well after from six to eight years, which means a cure of 49 per cent. Comparing this to the cases treated by radium, we see that the percentage of cures after radium in operable and borderline cases of carcinoma of the cervix is one-third less than after operation at the end of six years. When the cases are only observed over a period of three years the results of radiation surpass those of operation in cervical cancer, since 55 per cent. of the operable cases remained well. It has been stated that recurrence of carcinoma after it has been healed by radium will occur within the first year if it is going to occur at all, but Bumm has found this to be wrong, as he has had many recurrences after one, two and three years. There were 22 cases of carcinoma of the vagina in this series of which 22 per cent. were healed at the end of three years, which is a better result than is found after operation. Of 13 cases of cancer of the vulva, 9 have already died of recurrence. Of

the 5 cases of urethral cancer that he treated, 3 have remained well, a cure of 60 per cent. The author states that in general the soft medullary cancers are more easily influenced by radiation than the hard growths and adenocarcinomata, but every case is different as regards treatment and no standard dose can be stated for all cases. As a result of his work he concludes that it is not proper to treat all genital carcinomata by radiation. Cancer of the mammary gland, vulva and ovary should be operated upon and then subjected to radiation. Likewise cancer of the fundus should be operated upon when the condition of the patient permits. On the other hand all cancers of the vagina and urethra should be radiated instead of operated upon. In cancer of the cervix, he prefers operation when the case is early and the patient in reasonably good condition. In cases in which operation is contra-indicated on account of age, general condition, heart or bloodvessel radiation should be resorted to.

		1913		Cured.	Cured, per cent.
Type.		Number.			
Cervix,	operable	14		4	28.5
	borderline	22		5	23.0
	inoperable	42		2	4.7
Fundus,	operable	1		0	
Vagina,	operable	2		1	
	inoperable	7		0	
Urethra,	operable	1		1	
Vulva,	operable	1		1	
Recurrences after operation		25		0	
		1914		Cured.	Cured, per cent.
Type.		Number.			
Cervix,	operable	20		4	20.0
	borderline	21		4	19.0
	inoperable	36		2	5.5
Fundus,	operable	3		1	
Vagina,	inoperable	5		0	
Vulva,	operable	7		3	
Urethra,	operable	2		2	
	inoperable	2		0	
Recurrences after operation		37		5	13.5
		1915		Cured.	Cured, per cent.
Type.		Number.			
Cervix,	operable	40		22	55.0
	borderline	38		15	39.0
	inoperable	49		5	10.0
Fundus,	operable	1		0	
Vagina,	operable	4		2	
	inoperable	4		2	
Vulva,	operable	5		0	
Recurrences after operation		12		0	

A Study of Bladder Function.—Incomplete evacuation of urine from the kidneys or bladder is not infrequent and CURTIS (*Surg. Gyn., and Obst.*, 1919, xxix, 24) believes that it deserves more investigation than has been accorded it. He has been studying that phase of the subject which has to do with failure to empty the bladder, using for this purpose the bladders of twenty-two male rabbits, which were paralyzed by cutting the spinal cord. This injury produces a bladder paralysis entirely analogous to that which occurs in soldiers consequent to gunshot injuries of the spine and cord. The animals were housed in sanitary

cages which permitted immediate drainage of voided urine. The buttocks and genitalia were kept clean through shaving, aided by bathing and application of petrolatum many times daily. Bladder paralysis was obtained in every case and vesical distention was present in all except one rabbit which died three days after operation. The degree of distention was moderate in eight; in the other thirteen cases the bladder filled the entire lower abdominal cavity. One rabbit without anatomical obstruction to the urinary flow, died in consequence of spontaneous rupture of the bladder. Extensive vesical erosions or ulceration occurred in nine instances, while hemorrhages in the sub-mucosa were frequent. The ureters of four were not distended and those of three were doubtful, whereas fifteen were unquestionably dilated, some to an extreme degree. Of the dilated ureters both were involved eight times, the left alone five times, the right alone twice. The kidneys were of much interest. Of the 22 cases, 7 were normal and 15 pathological. The microscope revealed that 7 had nephritis, and 6 showed notable round-cell infiltration. Intense congestion with more or less hemorrhage was frequent. Bacteriological study showed that infection was evident in 12 of the 22 cases. Of these, the mucosa of one ulcerated bladder was packed with polynuclear leukocytes, but bacteria were not obtained. In the other 11 infected cases many bacteria were found in smears and cultures; one of them must be excluded from consideration because there was an associated beginning peritonitis, leaving 10 cases of undoubted urinary tract infection with numerous bacteria in every instance. These experiments upon rabbits indicate that the unrelieved paralyzed bladder offers a two-fold menace to health: (1) through frequent infection of the urinary tract due to contamination of static urine; (2) through back-pressure which distends the ureters, seriously interferes with kidney function and damages the kidney tissue. It would appear advisable, therefore, to maintain the paralyzed bladder in a state of freedom from residual urine, thus minimizing the danger of kidney involvement. From a clinical standpoint this study would seem to show that irregularly performed catheterization for retention of urine is unsatisfactory and patients so treated are subjected to such dangers as accompany the passage of the catheter and at the same time are rendered liable to accumulations of infected stagnant urine. On the other hand, carefully managed catheterization of the bladder which fails to empty spontaneously, yields excellent results; the catheter should be regularly passed often enough to prevent vesical distention and its use must be persisted in until daily tests show that residual urine is no longer being retained in the bladder.

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ORIGINAL ARTICLES

RECENT ADVANCES IN GASTRIC PHYSIOLOGY.¹

BY WALTER C. ALVAREZ, M.D.,

INSTRUCTOR IN RESEARCH MEDICINE, UNIVERSITY OF CALIFORNIA.

(From the George Williams Hooper Foundation for Medical Research, University of California Medical School, San Francisco, California.)

IN the lower animals and in embryos the gastro-intestinal tract is a simple tube from pharynx to anus. The stomach is formed by the bulging and bending of this tube and by the addition of one or more cecal pouches. In a 10-mm. human embryo the stomach is made up of three parts: The expanded lower end of the esophagus, the long tubular antrum (almost indistinguishable from the duodenum) and a small fundus. The end of the esophagus meets the pyloric antrum at the incisura angularis. Later, the fundus grows at the expense of the other parts, so that in the adult the pyloric antrum is comparatively small and the end of the esophagus is represented only by the cardiac antrum and a prolongation along the lesser curvature which forms the gastric canal.² (See Fig. 1.) Remnants of the "primitive tube" must then be looked for along the lesser curvature. It is interesting that this region is lined by a mucous membrane very similar to that in the bowel, whereas in other parts of the stomach we find the highly differentiated acid-forming cells.³

¹ Read before the American Gastro-enterological Association, Atlantic City, June 9, 1919.

² Lewis: *Am. Jour. Anat.*, 1912, xiii, 500. Keith and Jones: *Jour. Anat. and Physiol.*, 1902, xxxvi, 34.

³ Bensley: *Am. Jour. Anat.*, 1902, ii, 122. Lansdown and Williamson: *British Jour. Surg.*, 1914, ii, 308. Haane: *Arch. f. Anat. u. Physiol., Anat. Abth.*, 1905, 1.

There is considerable evidence for the view that the rhythmicity of the primitive gastro-intestinal tube was graded downward from pharynx to anus much as the rhythmicity of the primitive heart tube is graded from the venous to the aortic end.⁴ During its development the heart tube is twisted on itself and develops bulgings in which the future auricles and ventricles are to be. In these regions the muscle is specialized so that it can contract more quickly; it becomes more like striated muscle, and in so doing it loses much of its original rhythmicity.⁵ Through all these changes, however, a small strip of primitive highly rhythmic tissue remains, with its venous end still acting as the pacemaker. Similarly in the stomach we shall see that specialization in function has been accom-

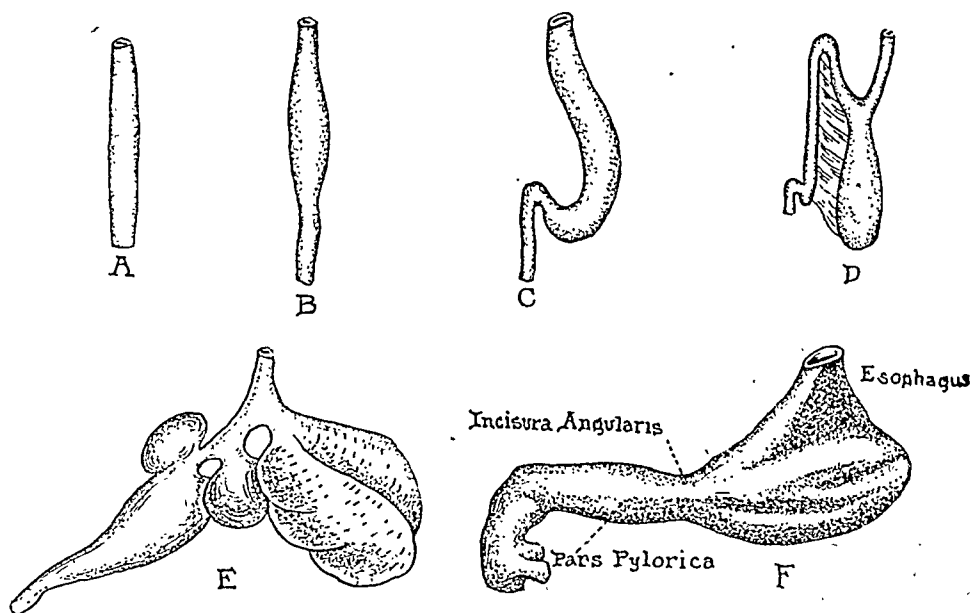


FIG. 1.—To show the development of the stomach. (a) Stomach of the pickerel (Nuhn); (b) stomach of *Proteus anguineus* (Nuhn); (c) stomach of *Scincus ocellatus* (Nuhn); (d) stomach of the eel (Huntington); (e) scheme of the ruminant compound stomach (Nuhn); (f) stomach of a 10 mm. human embryo (Lewis).

panied by a specialization in the muscle and a loss in rhythmicity. As we should expect, the most rhythmic muscle is to be found along the lesser curvature with what may perhaps be likened to a pacemaker at the cardia. Although the analogies are close, to avoid confusion it must always be remembered that the functions of heart and stomach are very different. In one the impulse spreads so rapidly that the organ appears to contract as a unit; in the other a series of waves travels slowly over the sac, gently kneading its contents.

⁴ Alvarez: *Am. Jour. Physiol.*, 1916, *xl*, 585.

⁵ Gaskell: *Schäfer's Text-book of Physiology*, London, 1900, *ii*, 177.

Differences in rhythmicity were shown by cutting off little strips of muscle from different parts of the stomach and getting them to contract in warm aerated Locke's solution. The segment from the lesser curvature next to the cardia always showed the greatest tendency to rhythmic contraction. Strips from the greater curvature, and particularly from the pyloric antrum, were slow in starting and many would not contract at all. Fig. 2 shows that the rate of contraction was fastest at the cardia and that it decreased progressively to the pylorus. The amplitude of contraction was small near the cardia and along the lesser curvature. It was larger in the pre-antral region and largest in the antrum. These peculiarities were found not only in various animals, but also in the stomach of an executed criminal obtained a few minutes after death. (See Fig. 3.)

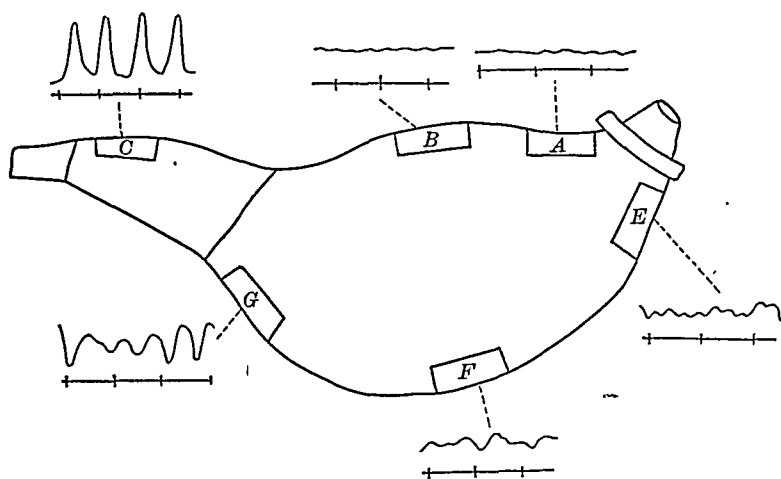


FIG. 2.—A diagram of the cat's stomach to show the location of the principal strips studied and the types of tracing peculiar to the different regions. The time tracing represents thirty-second intervals.

If we watch the human stomach with the fluoroscope the contractions seem to begin on the greater curvature near its middle or a little below. As they approach the antrum they deepen and suddenly their whole character changes. The indentation becomes equally deep on the two curvatures, so that the wave may cut the stomach shadow almost in two. It seems to me that these local differences in the peristaltic wave correspond perfectly to the regional peculiarities of tone and amplitude in the muscle through which it must pass. Serial roentgen-ray plates show that the waves do originate near the cardia, but that there they are very shallow.⁶ It is probable, then, that the waves which seem to begin in the lower third of the stomach have come as ripples from the highly rhythmic region on the lesser curvature near the cardia.

⁶ Groedel: *Die Magenbewegung*, 1912, p. 68. Dietlen: *Ergebnisse d. Physiol.*, 1913, xiii, 87.

Although the direction of peristalsis may be maintained by or due mainly to the gradient in rhythmicity, other important and closely related gradients can be demonstrated. In the first place the region around the cardia is the most irritable part of the stomach. It also has the shortest latent period.⁷ Fig. 4 shows how the latent period is graded from one end of the stomach to the other. The importance of this gradation is shown best in the simple stomach of the frog. There an electric stimulus to the pyloric antrum will show itself as a contraction in thirteen or four-

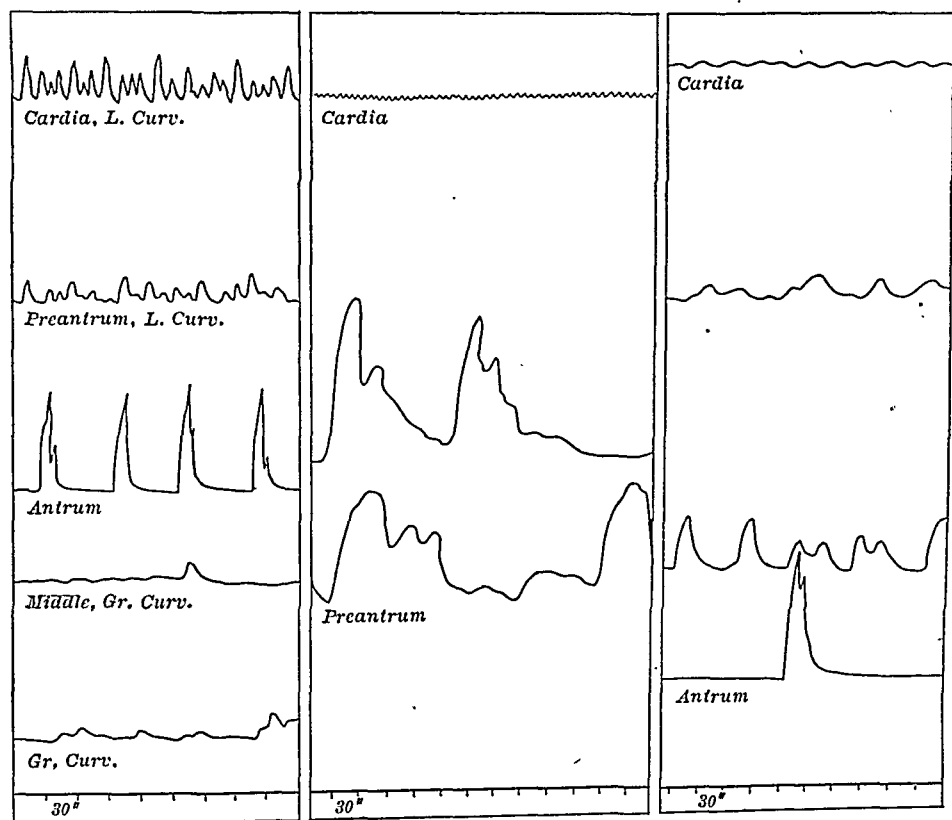


FIG. 3.—Records from five strips from different parts of the dog's stomach; of three strips from the lesser curvature of the human stomach and from four strips from the greater curvature of the human stomach.

teen seconds. Before that time elapses, however, the stimulus spreads to the cardia, where, after eight seconds, it shows itself as a peristaltic wave. This wave gets well down toward the pylorus before any change is visible at the point stimulated. We see then that this mechanism alone could ensure the aboral direction of peristalsis.

The same gradation in the latent period was shown in the excised strips of muscle when they were stimulated in a warm, moist

⁷ Alvarez: Am. Jour. Physiol., 1916, xli, 321.

chamber.⁸ This study again brought out marked differences in the characteristics of the tissue from different parts of the stomach. The cardiac muscle was very delicate and suffered a great deal from the trauma of excision, handling and stimulation. The antral muscle, on the other hand, was tough and would react well after much trauma. It reacted even better after it had been in the ice-box for forty-eight hours than it did at first. The cardiac muscle often would not react at all after such treatment. The shape of the contraction curve on the smoked drum was different and characteristic for different regions of the stomach. The muscle from the fundus showed a great tendency to remain tonically contracted after stimulation while the antral muscle relaxed promptly. The pyloric antrum seems to be particularly fitted to carry on the active muscular work of the stomach while the fundus serves to

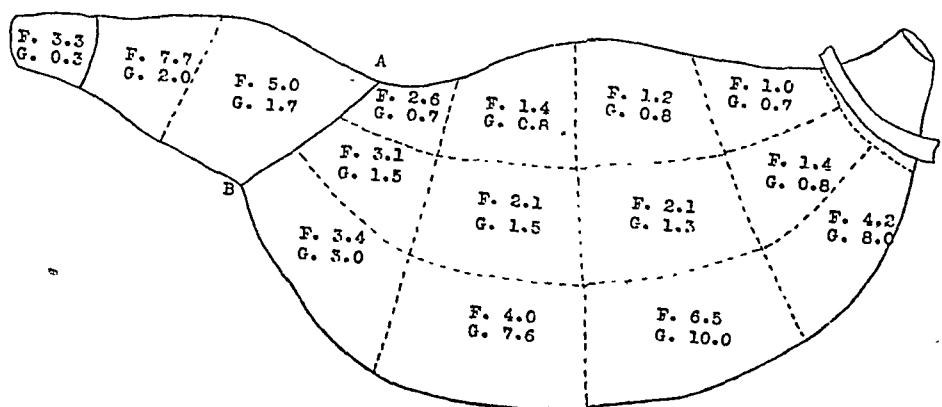


FIG. 4.—Anterior surface of the stomach of the cat, showing the average latent periods after faradic and galvanic stimulation in different regions. The figures indicate seconds. *A B* is the dividing line between the pars pylorica and the body of the stomach. The other unbroken line represents the pylorus.

maintain a steady tonic pressure on the contents. The muscle from the antrum has a color different from that in the rest of the stomach: it is redder and tough like a gizzard. The muscle in the pacemaking region is the softest to the touch.

UNDERLYING METABOLIC DIFFERENCES. As one after another of these regional differences came to light it seemed to me that there must be underneath them all differences in chemical structure and in the rate of metabolism. The first work on this problem was done on the small intestine.⁹ Little difficulty was encountered there in demonstrating a gradient of CO_2 production in the muscle from the duodenum to the ileum. Remarkably parallel to this gradient was a gradient of catalase content. Catalase is the ferment which liberates oxygen from hydrogen peroxide. A great

⁸ Alvarez: *Am. Jour. Physiol.*, 1917, xlii, 422, 435.

⁹ Alvarez and Starkweather: *Ibid.*, 1918, xlv, 186.

deal of work has been done which indicates that in some way this substance is involved in the process of tissue oxidation. Tissues with high rates of oxidation usually have more catalase per unit of weight than have tissues with slower rates of oxidation. It seems most likely, then, that the gradient of catalase content which Miss Starkweather and I have found in the wall of the stomach represents a gradient of metabolic activity.¹⁰ This gradient corresponds quite well to the gradient of rhythmicity already established. Furthermore, just as there is a sudden change from a low rhythmic rate in the antrum to a fast rate in the duodenum, so we find an abrupt rise in the catalase content as we cross the pyloric line.

So far very little work has been done on the anatomical side of the problem. Keith¹¹ has found nodal tissue in the highly rhythmic area on the lesser curvature near the cardia. Openchowski¹² found peculiar ganglion cells around the cardia different from those in Auerbach's plexus. Schütz¹³ and L. R. Müller¹⁴ have made similar observations. Although big histological differences have been found in striated muscles and in the heart, very little attention has been paid to this point in the stomach and intestine. McGill¹⁵ found an embryonic type of smooth muscle persisting in some parts of the tract, but unfortunately does not remember just where these islands were.

More work should be done also on the pylorus. It is not generally known that there is a fairly complete connective-tissue barrier between the muscle of the antrum and the duodenum. Ordinarily there are only a few bundles from the longitudinal coat which pass over.¹⁶ This explains the fact that the gastric waves do not run over on to the duodenum. Graphic records show that some influence may pass over to start peristaltic rushes in the bowel, but the deep waves, visible to the unaided eye, certainly stop at the barrier.

CLINICAL APPLICATIONS. After years of experiment it has been established that the stomach can perform its functions quite satisfactorily after section of all extrinsic nerves.¹⁷ Now, we see that these functions are probably dependent upon graded differences in rhythmicity, irritability, latent period and metabolism in the local neuromusculatory apparatus. If this is true, then any changes in these gradients must influence the peristalsis and the emptying time of the stomach. Such changes have been found in sick animals. In distempered dogs and snuffling cats the gradients of

¹⁰ Alvarez and Starkweather: *Am. Jour. Physiol.*, 1918, xlvii, 60.

¹¹ *Lancet*, 1915, ii, 371.

¹² *Deutsch. med. Wehnschr.*, 1889, xv, 717; *Zentralbl. f. Physiol.*, 1889, iii, 2.

¹³ *Arch. f. Verdauungskr.*, 1908, xiv, 242.

¹⁴ *Arch. f. klin. Med.*, 1911, ci, 421.

¹⁵ *Am. Jour. Anat.*, 1909, ix, 528.

¹⁶ Cunningham: *Tr. Roy. Soc. Edinburgh*, 1905-07, xlv, 9. Brinton: *Diseases of the Stomach*, London, 1859, p. 268.

¹⁷ Cannon: *Am. Jour. Physiol.*, 1906, xvii, 429.

latent period and metabolism were often reversed and practically always made irregular and less steep. This was due probably to the fact that the muscle at the cardia is so much more sensitive to adverse conditions and probably to disease toxins than is the pyloric muscle. Similar upsets were observed in the intestinal gradients in these sick animals.

The gradient might be reversed also by an irritating lesion, such as an ulcer near the pylorus, which could raise the metabolic rate in the surrounding muscle above that near the cardia. Such a reversal would probably give rise to the anastalsis which is seen sometimes with the roentgen rays.

A number of surgeons have commented on the fact that a V-shaped excision of an ulcer on the lesser curvature is likely to interfere with the emptying of the stomach while a sleeve resection usually gives a much better result.¹⁸ We can probably explain that now in the following way: Ordinarily the wave originating at the cardia has to travel faster along the greater curvature than along the lesser curvature because the greater is longer. Apparently both sides of the wave must reach the pylorus at the same time in order to secure good emptying. Now, time and time again while watching the human stomach under the screen I have seen the two sides of the wave reach the antrum unevenly, so that they met not at the pylorus but at a point on one side or the other. Sometimes this was due to an ulcer on the lesser curvature, and at other times I could not see what had interfered with the conduction. Sometimes the arrival of part of the wave at the pylorus seemed to block the other part of it still advancing along the greater curvature. It seems to me probable that such differences in conduction would be still more exaggerated after an operation which shortens the lesser curvature. Under these circumstances one side of the wave might reach the pylorus long before the other. Theoretically a sleeve should be removed with a longer side on the greater curvature than on the lesser.

While watching gastric peristalsis in the rabbit and also in man it has often seemed to me that there must be a wave of excitation travelling ahead of the visible contraction. Owing to its greater irritability and shorter latent period the pyloric ring responds to the excitation a little ahead of time. The resulting contraction blocks the advancing peristaltic wave and keeps it from putting any pressure on the sphincter. This may explain why some stomachs do not empty well in spite of good peristalsis and a patent pylorus. Time and again in cats I have watched a similar mechanism at work at the ileocecal ring causing it to contract firmly in the face of advancing colonic waves. The contraction ring thus

¹⁸ Mayo: Jour. Am. Med. Assn., 1915, lxv, 1073. Stewart and Barber: Ann. Surg., 1916, lxi, 527.

formed served to block these waves before they could put much pressure on the sphincter.

While peeling off the strips of muscle it was found that the submucosa was quite deficient along the lesser curvature from the cardia to the antrum. The mucosa is fastened to the muscle there much as the skin is to the palmar fascia of the hand. In the rest of the stomach, and particularly in the antrum, the strips could be peeled off easily. These differences may have some influence on the spread of carcinoma and on the penetration of ulcer.

It is an interesting observation that in animals the region corresponding to the duodenal cap has a poor rhythmicity. Excised segments put into warm oxygenated Locke's solution often do not contract at all, and when they do they generally show an irregular rhythm with small amplitude. This may be due partly to the peculiar festoon-like arrangement of the muscle fibers in this region. As would be expected, this comparatively inactive segment, situated as it is between two strong and active ones, tends to remain filled with food for long periods of time.

It is a well-known fact that carcinoma very rarely originates in the duodenum, and when it begins in the stomach it will not spread across the pyloric line. It seems probable now that this is due to a difference in metabolic rate on the two sides of that line. Estimations of the catalase content of the mucous membrane from different parts of the digestive tract showed that the lowest figures are to be obtained in the pyloric antrum and the highest in the duodenum.¹⁹ (Fig. 5). Now, Child²⁰ has shown, with simple forms of life, that the embryonic, undifferentiated and rapidly growing cell loses its capacity for growth as it fills up with the comparatively stable structural substances which are acquired during differentiation and specialization. This process leads to senescence and death. After the metabolism has become greatly slowed these cells may suddenly begin to use up this metaplastm; they dedifferentiate and reacquire the faculty of growth. Goodpasture²¹ has recently pointed out how this mechanism, so useful in the rejuvenation of simple forms of life, can threaten the existence of the higher forms. It may be, then, that that part of the gastric mucous membrane with the lowest metabolic rate is, as it were, most senile and therefore most subject to cancer. Tumors originating there cannot spread into a mucous membrane which is kept young by its high metabolic rate.

One other thing might be mentioned, and that is the apparent uselessness of gastric faradism as a therapeutic measure. I found it impossible sometimes to get contraction of the gastric muscle when strong currents were applied directly to the serous coat. This was observed not only on animals opened under an anesthetic,

¹⁹ Alvarez and Starkweather: *Am. Jour. Physiol.*, 1918, xlvii, 67.

²⁰ *Senescence and Rejuvenescence*, Chicago, 1915.

²¹ *Jour. Med. Res.*, 1918, xxxviii, 127.

but also at operations on men and women. Meltzer²² found, many years ago, that it was almost impossible to stimulate the muscle through the mucosa. Even when the current gets through there is no reason to hope that it will act so appropriately as to restore the downward gradients when they have been altered by disease.

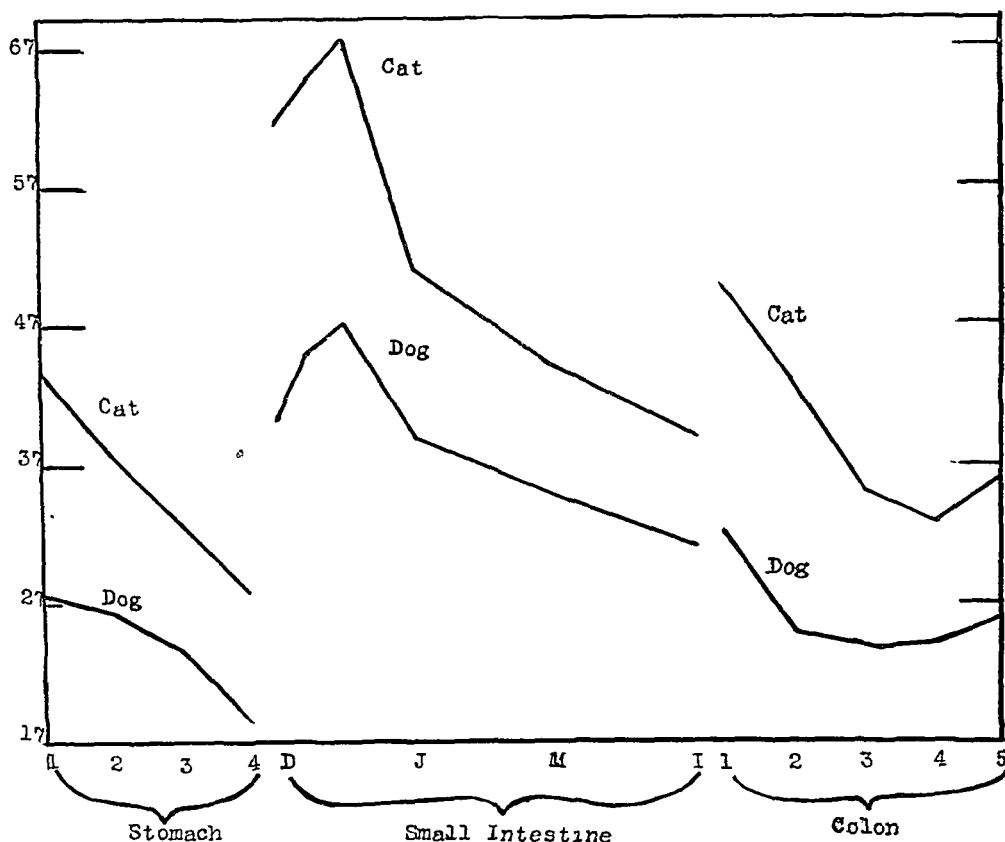


FIG. 5.—Shows the gradation in catalase content of the mucosa in different regions. The ordinates represent cubic centimeters of oxygen liberated in fifteen minutes by 0.2 gram of tissue.

SUMMARY. The gastro-intestinal tube may originally have been constructed so that the rhythmicity of any one segment varied inversely as the distance from the pharynx.

The stomach has been evolved from this simple tube much as the heart has been enlarged and specialized. The remnants of the primitive tube are to be looked for along the lesser curvature.

A highly rhythmic area has been found on the lesser curvature near the cardia.

Strips of muscle excised from different parts of the gastric wall can be made to beat rhythmically in warm, aerated Locke's solution. Speaking roughly, the rate of contraction varies inversely as the distance from the cardia.

²² New York Med. Jour., 1895, lxi, 746.

Differences in the depth of the waves as they sweep over the stomach can be explained by differences in tone and amplitude of contraction of the muscle in different parts of the organ.

There is a gradient of irritability from cardia to pylorus. The latent period is shortest near the cardia and longest in the pyloric antrum.

The muscle in the pars pylorica appears to be quite different from that in the rest of the stomach. It is especially fitted to do the hard work of that organ.

The pyloric ring is more irritable and has a shorter latent period than that of the pyloric antrum. This may have considerable bearing on the problems of poor gastric emptying in ulcer.

The duodenum is much more irritable than the antrum and its rhythmic rate is much higher.

The muscle on the lesser curvature near the cardia is very sensitive to trauma and to adverse conditions which seem to have no effect on the muscle from the antrum. This difference may account for the fact that the normal downward gradients of rhythmicity and latent period were altered and even reversed in sick animals.

Evidence is presented which suggests strongly that there is a gradient of metabolism underlying and perhaps giving rise to the gradients of irritability, latent period and rhythmicity which, it is believed, determine the direction of peristalsis. The metabolic gradient is often found reversed in sick animals which are refusing food.

There appears also to be gradient of metabolism in the mucous membrane of the stomach. The lowest values in the whole digestive tract are found in the antrum. It is shown how this may explain the high incidence of cancer in that region and the inability of the tumors to cross over into the duodenum, where there is a very high metabolic rate.

An explanation is given for the fact that a sleeve resection gives a better functional result in ulcer of the lesser curvature than a V excision.

PERSISTENT EOSINOPHILIA WITH HYPERLEUKOCYTOSIS AND SPLENOMEGALY.¹

By H. Z. GIFFIN, M.D.,

DIVISION OF MEDICINE, MAYO CLINIC, ROCHESTER, MINNESOTA.

As the basis for a discussion of eosinophilia I wish to review a case which seems to be unique in medical literature: eosinophilic hyperleukocytosis associated with marked splenomegaly and mod-

¹ Presented before the Association of American Physicians, June 16, 1919, Atlantic City, N. J.

erate glandular enlargement. This case suggests a consideration of (1) the origin and function of the eosinophils, (2) the clinical incidence of eosinophilia, (3) the occurrence of eosinophilia with hyperleukocytosis, and (4) the possibility of the existence of an actual eosinophilic leukemia, apparently following splenectomy in a case of eosinophilic hyperleukocytosis.

CASE 81201.—*F. H., male, aged thirty-one years. Marked splenomegaly. Slight enlargement of superficial lymphatic glands. Leukocytosis 21,800 before splenectomy, with an eosinophilia of 73.6 per cent. Splenectomy July 15, 1914. Weight of spleen 2110 grams. Macroscopic appearance of spleen similar to that of myelogenous leukemia. Rapid increase of leukocyte count to 97,200 and later to 211,000, eosinophilia from 79 to 90.7 per cent. Good general condition for period of four years following splenectomy. Death January 19, 1919, of empyema following pneumonia. Necropsy: Enormous numbers of eosinophilic polymorphonuclears in all hemopoietic organs. Eosinophilic myelocytes numerous in lymph glands, spleen and bone-marrow. Obliterative pericarditis and fibrous perihepatitis.*

March 11, 1913, a man, aged thirty-one years, with generalized anasarca and moderate anemia, presented himself for examination. His family history was negative. He had had a continuous fever, with the characteristics of typhoid fever, eight years previously, and this had been followed by pneumonia. Convalescence from this severe illness was protracted and the patient had not since that time entirely regained his former strength. Eighteen months before the examination he developed moderate dyspnea and a cough; he had an occasional attack of vomiting and some wheezing, but did not have a typical paroxysmal asthma. Thirteen months before, he had been much annoyed by a severe recurrent pain in the left thoracic region; this, in the light of later findings, may have been due either to a pericarditis, a pleurisy or to a perisplenitis. Ten months before examination a transitory edema of the legs and face developed, which would disappear during the night. Five weeks previous to examination the patient became quite ill with cough, shortness of breath and wheezing, without chill or fever. He could not work, but was not confined to bed. Three weeks before examination he began to suffer from a moderately severe pain at the right costal margin, associated with vomiting and questionable jaundice. One week before examination a generalized edema developed and became progressively worse.

The general physical examination showed a marked superficial edema of the legs and body up to the level of the arm-pits. The scrotum was edematous; evidence of ascites was present, the liver and spleen were enlarged and the axillary glands were easily palpable. There was no definite evidence of lues and the Wassermann test was negative. There was no indication of nephritis. The acute condition at that time seemed to be due either to a myocardial insufficiency or a cirrhosis of the liver.

The most interesting finding, however, was the presence of eosinophilia of 66.3 per cent. (see Table). The leukocyte count at the time of the first examination in March, 1913, was 15,400; the total lymphocyte count was 19.3 per cent. while the polymorphonuclear count was only 13 per cent. The anemia itself was of a secondary type, with a red cell count of 3,620,000 and a hemoglobin of 69 per cent. On account of the extremely high eosinophilia a very careful search for parasites was made. The stools were repeatedly negative and a microscopic examination of skeletal muscle was negative.

BLOOD COUNTS (CASE 81,201, F. H.).

	Mar. 11, 1913.	Dec. 16, 1913.	July 14, 1914.	Aug. 5, 1914.	Nov. 24, 1914.	May 25, 1915.	Dec. 5, 1916.	May 15, 1917.	Oct. 10, 1917.	Nov. 26, 1918.
e										
hemoglobin	69	80	75	68	85	70	69	52	58	50
red blood cells (millions)	3.62	4.16	3.86	4.02	4.60	3.56	4.25	3.48	3.62	2.72
total blood cells . . .	15,400	15,400	21,800	97,200	133,000	203,000	103,000	211,000	135,000	81,800
total lymphocytes . . .	18.3	16.0	9.6	6.8	11.3	5.0	9.0	3.7	5.3	5.0
large lymphocytes . . .	1.0	4.8	6.0	1.2	1.3	4.2	0.3	1.0	2.0	1.7
polymorphonuclears . .	13.0	19.4	9.8	12.4	10.0	6.8	6.7	4.3	5.7	7.0
eosinophils	66.3	57.6	73.6	79.0	75.0	83.4	83.0	90.7	87.0	84.0
basophils	1.3	2.2	1.0	0.6	2.3	0.4	..	0.3	..	0.7
reticulocytes . . . . .	..	..	..	..	..	..	0.3	..	..	..
myelocytes . . . . .	..	..	..	..	..	0.2	..	..	..	0.7
myeloblasts . . . . .	..	..	..	..	..	1.	1.	..	..	1.

A lymph gland removed from the axilla for microscopic examination showed a moderate inflammatory reaction. The germ centers were intact; a marked endothelial hyperplasia was present. Eosinophilic polymorphonuclear leukocytes were quite numerous and a few scattered eosinophilic myelocytes were to be found.

The patient was placed at absolute rest in bed on a milk diet; his edema practically disappeared within ten days. The spleen was then easily outlined and was found to extend to the navel and to the level of the left iliac spine. Two months later the patient was able to do light work. During the summer and fall of 1913 he worked moderately hard and quite regularly. In June, 1914, more than one year after the original examination, the patient's general condition was fairly good. His anemia, however, was quite definite; the red cell count was 3,500,000, the eosinophile percentage was 75.4, while the total leukocyte count was 13,800.

In view of the persistence of a chronic anemia of the secondary type and the presence of a marked splenomegaly, splenectomy was decided on. The operation was performed on July 15, 1914, by W. J. Mayo. The spleen was very large, measuring approximately ten inches by 12 inches, and weighing 2110 grams. Extensive perisplenitis was present and the organ was almost completely adherent to the vault of the diaphragm, to the wall of the stomach and to the parietal peritoneum. Macroscopically it had the appearance of the

spleen in myeloid leukemia. The liver, especially the left lobe, was very large. A small amount of abdominal fluid was present. The gall-bladder was distended, but gall-stones were not palpable.

Splenectomy was followed by a gradual and steady improvement, especially with respect to the patient's strength and general condition. Within one month after splenectomy, however; the leukocytes had risen from 21,800 to 97,200, 79 per cent. of which were eosinophils. During the fall of 1914 the patient felt better than for seven or eight years. His weight was 159 pounds and he was able to do light work. The liver remained enlarged and in November, 1914, it extended three finger-breadths below the costal margin. The superficial glands in the neck and axilla were easily palpable. During 1915 the patient's general condition was quite satisfactory, aside from slight shortness of breath on exertion. During the winter of 1916 there was a slight increase in the size of the liver and a superficial edema was occasionally present, but by summer the patient was so improved that he was able to do regular farm work. A pruritus of indeterminate type developed; this may have been an expression of the patient's chronic toxemia. In 1917 the patient's general condition was quite satisfactory except for occasional attacks of pruritus and of moderate dyspnea and edema. October 10, 1917, the leukocytes numbered 135,000, 87 per cent. of which were eosinophils. The patient continued to be in fairly good health until October, 1918, at which time a gradually increasing weakness, dyspnea and cough developed, later associated with an acute illness, which probably was pneumonia, as our examination in November, 1918, revealed evidences of unresolved pneumonia, and a roentgen-ray examination of the chest showed an infiltration in the region of the right middle lobe, together with a considerable enlargement of the cardiac shadow. The patient was anemic, the hemoglobin being 50 per cent. and the red cells 2,720,000. The patient was advised to have hospital care and observation, but this was refused; one month later he returned in a very bad condition. There was then evidence of fluid in the right pleural cavity. A catheter was inserted through a cannula and 1300 c.c. of yellow pus were aspirated. A culture showed pneumococci. Through an oversight a cellular and chemical study of the pus was not made. The pleural cavity was treated with Dakin solution. The patient's general condition was not satisfactory after the development of empyema, and on January 18, 1919, his temperature rose rather suddenly to 102°; he died January 19, 1919, probably as the direct result of bronchopneumonia.

Cytology of Blood Smears. A study of the blood smears revealed that almost all the eosinophils were of mature type and differed only slightly from the eosinophilic polymorphonuclears which are ordinarily found in the blood-stream. These cells were somewhat larger than usual and the number of nuclear lobes was increased. Many

cells had three lobes. The protoplasm seemed to be basophilic rather than neutrophilic and a considerable vacuolation was present while a few cells were ruptured. Certain eosinophils were to be seen in which a few small basophilic granules were present and an occasional eosinophil had the appearance of a transitional cell or metamyelocyte with a horseshoe nucleus. Rarely, however, was it possible to discover a true eosinophilic myelocyte in the blood smears (Fig. 1, a).

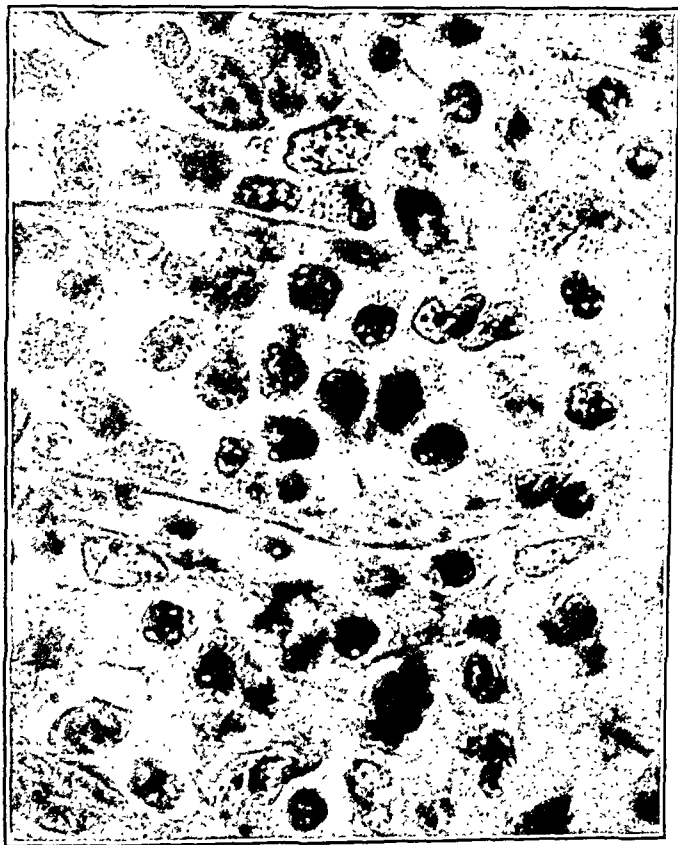


FIG. 2.—Microphotograph of spleen, showing eosinophilic polymorphonuclear leukocytes and myelocytes. They are not so plain in the spleen as they are in the lymph gland (Fig. 5), due to poor fixation.

*Examination of the Spleen Removed at Operation July 15, 1914.** The spleen, weighing 2110 grams, was approximately ten by twelve inches. The Malpighian bodies were intact though not numerous. Cellular hyperplasia was marked, eosinophilic polymorphonuclears were very numerous and a few eosinophilic and neutrophilic myelocytes were seen. The increase in the amount of fibrous tissue was only slight (Fig. 1). The myelocytes were much less numerous in

* Examination of tissues was made by A. C. Broders.

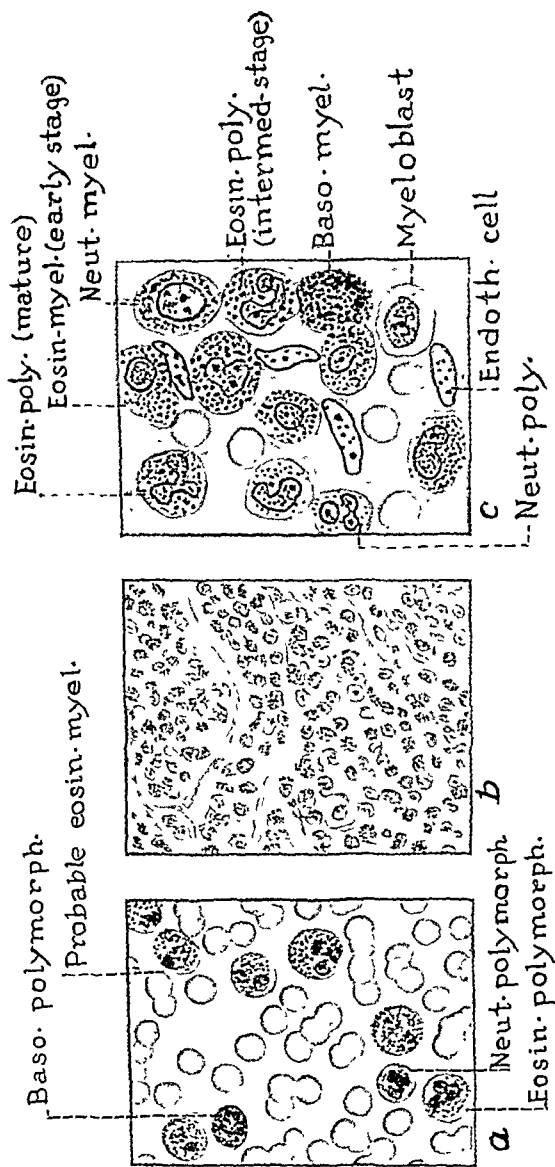


Fig. 1.—Drawings of Actual Fields to Show Eosinophiles.

- a. Eosinophiles in the blood stream, observed with 10 X ocular and $\frac{1}{2}$ immersion oil objective.
- b. Bone-marrow cells showing remarkable predominance of eosinophilic myelocytes, $\frac{1}{2}$ objective, 10 X ocular.
- c. Bone-marrow under $\frac{1}{2}$ immersion oil objective and 10 X ocular.

the spleen, which was removed in 1914, than they were in the glands removed at necropsy four and one-half years later.

Examination of the Bone-marrow (Postmortem January 19, 1919.) The bone-marrow was hyperplastic and contained great numbers of eosinophilic polymorphonuclear leukocytes; the majority of them were in a well-developed stage while a few were apparently of intermediate type. Eosinophilic myelocytes were present in the proportion of 3 to 10 in favor of eosinophilic polymorphonuclears. An occasional neutrophilic polymorphonuclear and, very rarely, a basophilic myelocyte could be found. The erythrogenic function of the bone-marrow seemed to be almost in complete abeyance (Figs. 1b and c, and 3 and 4).



FIG. 3.—Microphotograph of bone marrow, showing numerous eosinophilic polymorphonuclear leukocytes and a few eosinophilic myelocytes. The coarse granules, often clumped at one side of the cell, are prominent. 10X ocular, $\frac{1}{2}$ objective, Jenner stain.

*Examination of the Lymph Gland from the Region of the Head of the Pancreas.** The gland was about 3 cm. in diameter. The germ centers were intact. Eosinophilic polymorphonuclears were very numerous. A few scattered eosinophilic myelocytes and neutrophilic myelocytes were found. The eosinophilic myelocytes occurred in the proportion of 1 to 10 in favor of the eosinophilic polymorphonuclears. The eosinophilic polymorphonuclears showed chiefly fully developed forms and occasionally intermediate forms. The

* Examination of tissues was made by A. C. Broders.

eosinophilic polymorphonuclears were almost as numerous as the lymphocytes (Fig. 5).



FIG. 4.—Microphotograph of bone-marrow, showing eosinophilic myelocytes and polymorphonuclear leukocytes.

Anatomic Diagnosis. Right bronchopneumonia; right fibrous pleuritis; obliterative pericarditis; fibrous perihepatitis; cirrhosis of the liver; general lymphoid hyperplasia. The obliterative pericarditis and the fibrous perihepatitis were probably of long standing and much of the symptomatology during the last six years of the patient's life could be attributed to cardiac and hepatic disease. While these latter pathological conditions were apparently of a chronic nature the cirrhosis of the liver was of mild grade and of mixed type, but a generalized fibrous peritonitis, commonly seen in Pick's or Concato's disease, was not present.

DISCUSSION.

1. *The Origin and Function of the Eosinophils.* Most hematologists subscribe to the heteroplasmic theory of the formation of granular cells, at the same time admitting the occurrence of

mitosis and the homoplastic origin of a certain number of these cells. They agree that eosinophilic polymorphonuclear leukocytes develop chiefly from undifferentiated mononuclear cells within the bone-marrow, and in smaller numbers within certain special tissues of the organism, particularly lymphoid tissue. Whether this development is a direct transformation from lymphocytes or is the result of maturation from metastatic bone-marrow tissue is undecided. In the case herewith reported the presence of eosinophilic myelocytes and immature forms of eosinophilic polymorphonuclears in the spleen and lymph glands indicates quite clearly

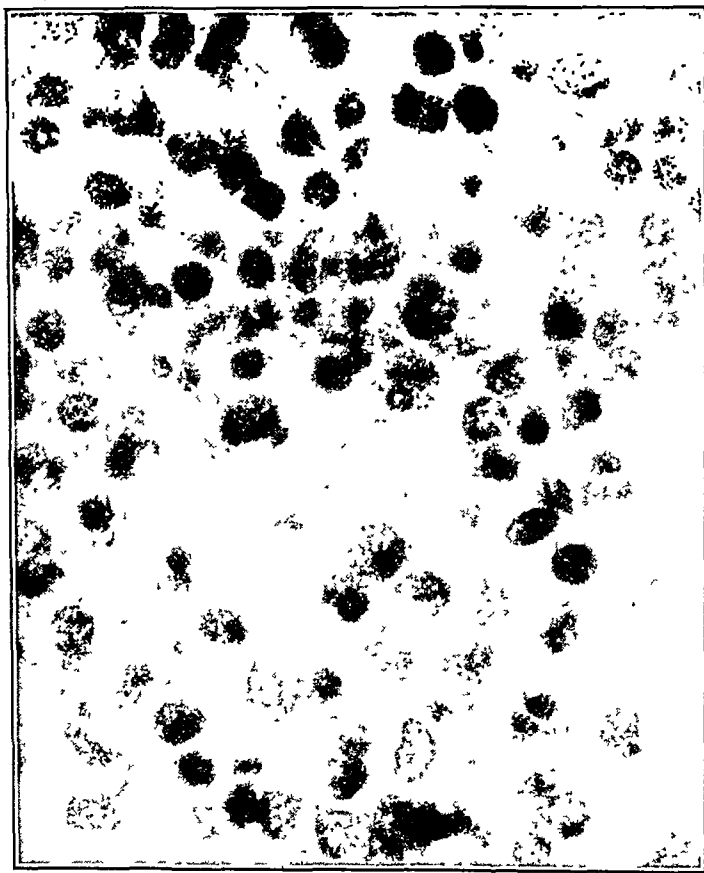


FIG. 5.—Microphotograph of large lymph gland near the head of the pancreas, showing numerous eosinophilic polymorphonuclear leukocytes and a few eosinophilic myelocytes.

either a normal or a perverted production of eosinophils within these organs. There is no conclusive evidence in favor of the theory of the direct transformation of neutrophilic polymorphonuclears into eosinophils either in the blood-stream or in the general tissues. The theory of the origin of eosinophilic granules from hemoglobin or its dissociation products is strongly advocated by Weidenreich. The recent work of Downey shows that in the bone-marrow of the adult guinea-pig eosinophilic granules are differen-

tiated gradually from a basophilic protoplasm and that their progressive evolution is marked by complex changes in staining reactions, size and shape, and also that there is a direct transformation from basophilic to oxyphilic granules. The complex evolution of the granules indicates that they are true endogenous formations. The granules of eosinophils even in the younger cells and before they become clearly oxyphilic can be differentiated from the granules of mast-cells by their size, shape and staining characteristics. Downey explains that there need be no conflict between his own conclusions concerning the endogenous origin of eosinophile granules in the bone-marrow and Weidenreich's demonstration of an exogenous origin as a result of phagocytic activity. This can be explained on the basis of Gütig's theory that two types of eosinophils exist and that, morphologically, they are distinguishable.

Very few facts concerning the function of eosinophils are known. Complete withdrawal of food is followed by a decrease of eosinophils in the peripheral circulation. There is a relationship between nutrition and the production and circulation of eosinophils and disturbances of nutrition affect the multiplication of eosinophils more readily than that of the finely granular leukocytes (Opie). Schwarz believes that there are indications of a very close relationship between eosinophils and intestinal secretion and that possibly these cells may convey a hormone which is important for proper cellular activity in the intestine. Falta and his co-workers call attention to the fact that pilocarpin and pituitrin, substances which raise the tonus of the autonomic nervous system, also produce eosinophilia.

Lepsky concludes that eosinophilia is, in some measure, a reaction of the organism against the penetration of foreign proteins. Weinberg and Séguin, in 1915, confirmed the work of Mesnil and others by demonstrating that eosinophils possess important phagocytic properties with respect to both bacteria and cells; they also showed by the use of hydatid fluid that eosinophils are well adapted to the absorption of toxic products. In their experiments those eosinophils which had absorbed toxic material lost their phagocytic properties while these properties were retained by the neutrophilic and mononuclear cells and the hydatid liquid itself lost its antigenic power. Fiessinger recently has shown that there is a definite anti-toxic leukocytic reaction and defense against the foreign proteins formed in war wounds as the result of infection and the destruction of tissue and that eosinophils are concerned in the mechanism of this defense. All of these observations lead to the conclusion that eosinophils may play an important role in the maintenance of immunity.

2. *The Clinical Incidence of Eosinophilia.* Eosinophilia has been described in association with many conditions, although, in most of them the percentage is neither high nor persistent. A low grade of eosinophilia is found in some cases of scarlet fever, neurasthenia

and polycythemia. A constant slight relative and marked absolute eosinophilia is present in myelogenous leukemia. Eosinophilia also is associated with the presence of parasites and its occurrence in asthma and in certain cutaneous diseases is well established. The most marked eosinophilias which I have been able to find reported in medical literature have occurred in cases of trichinosis, in which the eosinophilia is transient, of lymphadenoma, especially associated with cutaneous lesions and occasionally in cases of carcinoma and sarcoma. Reports of instances in which the eosinophils have even temporarily reached 25 per cent. or more are exceedingly rare. I have had under observation a patient (Case 104259) with Hodgkin's disease who had an eosinophilia of 33.3 per cent. with a leukocyte count of 12,000. The diagnosis was made after the excision of a gland for microscopic examination. No reason for the marked eosinophilia could be discovered. Aubertin and Girous describe a cardiac case with cyanosis and frequent attacks of decompensation in which a persistent and very high eosinophilia was present. The leukocyte count varied from 6900 to 13,500 and the eosinophils from 57 to 68.25 per cent. Dunger reports a case of probable carcinoma of the colon in which the leukocyte count was 35,330, 60 per cent. of which were eosinophils. Sibley reports an eosinophilia of 39.6 per cent. and a leukocyte count of 28,150 in a case of lymphadenoma associated with cutaneous lesions.

In none of these cases was a markedly enlarged spleen present; in only one instance was the eosinophilia persistent.

3. *The Occurrence of Eosinophilia with Hyperleukocytosis.* After a careful study of the literature only three instances of eosinophilia associated with hyperleukocytosis have been found. Glanzmann describes a case of lymphadenoma as "lymphatic endotheliomatosis," in which the leukocyte count varied from 12,000 to 183,000 and the eosinophiles from 4 to 33.6 per cent. Rheinbach reports a lymphosarcoma of the cervical region, with a leukocytosis of 120,000 and an eosinophilia of 48.28 per cent. The leukocytosis was transient and the eosinophilia fluctuating in these 2 cases. Stillman, in 1912, reported to the New York Academy of Medicine a case of persistent eosinophilia with hyperleukocytosis and splenomegaly. The features of Stillman's case conform closely to those of the case herewith reported, and it is the only similar case that I found in the literature. The leukocyte count varied from 118,000 to 165,000 and the eosinophiles from 85.8 per cent. to 91 per cent. The spleen was slightly enlarged and the lymph nodes were palpable. The patient was under observation for a short time only and his subsequent record is unknown.

4. *The Possibility of the Existence of an Actual Eosinophilic Leukemia.* Our knowledge of eosinophilia in general strongly favors the conclusion that an eosinophilic hyperleukocytosis is not a true

leukemia. The occurrence of eosinophilia has so far been most satisfactorily explained on the basis of the chemotactic theory. In cases of a very chronic type of toxemia or infection it is possible that certain poisons which are effective throughout the entire organism for years may induce a persistent eosinophilia of almost any degree. It has been repeatedly demonstrated that some substances may call forth a local eosinophilia which will have no recognizable effect on the blood count. When the process is more extensive and the chemical irritant affects larger parts of the organism or possibly when a different form of toxin is circulating the demand for increasing numbers of eosinophils, as well as the toxin itself, may react as a physiological stimulant to the production of eosinophils in the bone-marrow and in other hemopoietic structures. A perversion of these tissues may be the result.

In the case which has been reviewed those conditions which may be said to argue in favor of the existence of a true eosinophilic leukemia following splenectomy are as follows: (a) The persistently high leukocyte count, (b) the marked splenomegaly, (c) the general glandular hyperplasia, (d) the gross appearance of the glands, spleen, and bone-marrow, (e) the occurrence of a small percentage of immature cells and an occasional myelocyte in the blood smears, and (f) the presence of active hyperplasia in glands, spleen and bone-marrow, together with the presence in these tissues of numerous eosinophilic myelocytes.

The facts which constitute the evidence against the existence of an actual leukemia are: (a) The marked predominance of mature and almost mature eosinophils in the blood-stream and in the hemopoietic system, (b) the postmortem demonstration of an obliterative endocarditis, perihepatitis and hepatic cirrhosis, which would account for a greater part of the symptomatology during the entire course of the disease and would indicate the probable presence of a chronic toxemia, (c) the absence of hyperleukocytosis before splenectomy, (d) the long duration of the disease, approximately seven years and (e) the absence of the typical microscopic characteristics of leukemia.

While not entirely discarding the view that an eosinophilic leukemia may have been present at least after splenectomy, I am inclined to regard the case as an instance of eosinophilic hyperleukocytosis, the blood picture of which was remarkably altered by splenectomy. This permanent increase of the leukocytes following splenectomy for a period of four and one-half years considered in connection with the occurrence of a more or less constant eosinophilia after splenectomy for various other conditions, may be indicative of some special function of the spleen with respect to eosinophilic cells or with respect to the toxins which eosinophilic cells are capable of absorbing.

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MEDICAL ASPECTS OF WOUNDS OF THE CHEST IN WAR.¹

BY GEORGE CHEEVER SHATTUCK, M.D.,

ASSISTANT PHYSICIAN TO THE MASSACHUSETTS GENERAL HOSPITAL, BOSTON.

INTRODUCTION. The operative treatment of wounds of the chest as of wounds of other parts of the body is a duty of the surgeon requiring great technical skill, good judgment and mastery of the fundamental principles of surgery.

Chest surgery differs, however, in two important respects from most other classes of war surgery: (1) its field has been much enlarged during the war, and (2) some of the questions which arise in connection with chest cases are of a kind with which the physician is more familiar than the surgeon.

¹Read in part before the Association of American Physicians June 17, 1919. Service with the Harvard Unit at 22 General Hospital of the British Expeditionary Forces in 1916, 1917 and 1918 and attached to Casualty Clearing Stations at various times in 1917 and 1918.

For example, it may be important in a case to know whether the dyspnea is due to a large hemothorax, pneumothorax, pulmonary edema or massive collapse of the lung; whether the circulatory disturbance can be relieved by aspiration or is due to shock or to hemorrhage; whether the temperature is probably caused by infection of the hemothorax or due to some other cause.

The physician's experience in chest examination is helpful, and, what is even more important in times of stress, while the surgeon is constantly occupied in the operating room the physician has more time to study the cases in the ward and to direct treatment in detail.

For these reasons it early became the rule in some of the general hospitals at the bases of the British Army in France to send all cases of chest wounds to specified wards, where they came under the care of a physician who was responsible for them whether operated on or not. This experiment having given satisfactory results, physicians later coöperated with surgeons at some of the casualty clearing stations situated in the forward areas, where most of the early operating was being done, and, in the spring of 1918, the Second British Army appointed a physician for each of their clearing stations to take charge of cases of chest wounds and placed the responsibility for directing this work upon the consulting physician of that army.

The mortality of penetrating chest wounds at the casualty clearing stations was seldom less than 20 per cent. There was a further mortality of about 5 per cent. in cases sent from the clearing stations to the base, and a number of cases, but what proportion I cannot say, died on the field, at the regimental aid posts or at the field ambulances. The total mortality for chest cases, including those complicated by other wounds, was probably not less than 30 per cent.

Therefore, the opportunity to save life by improved methods was clear, many individuals applied themselves to the problem so far as opportunity permitted and great advances in knowledge of the subject were made.

My experience with chest wounds extended over two years and was about equally divided between a general hospital near Boulogne and various casualty clearing stations, to which I was attached from time to time. I have notes, but not as complete as could be wished, of between 400 and 500 cases, probably less than half the number that passed through my hands.

It should be borne in mind that conditions of work vary much in different places, and at different times in the same place, and that methods had to be adapted to conditions as they existed at the time.

None of the hospitals in which I worked had special equipment or facilities for handling chest cases. They were in no way comparable

to the few fortunate hospitals of De Page and others. Nevertheless, the average of efficiency in the British hospitals in France was extremely high. Their staffs of medical officers, nurses and nursing orderlies were ample for ordinary times, but whenever there was heavy fighting on that part of the front, much that might have been desirable to do was perforce neglected and pressure for available beds required evacuation at the earliest possible moment of every case that would not die of the journey. Consequently, no cases could be held for study. At the clearing stations even the severely wounded were seldom retained for more than a week.

CHEST WOUNDS AT A CASUALTY CLEARING STATION. The first question in chest cases is whether an operation should be performed. In reaching a decision the main points to be considered are the nature of the external wounds and of the missile which caused them, the probable intrathoracic lesions, the condition of the patient and the time elapsed after wounding.

Other problems of interest center around the preoperative and postoperative management, the care of cases not operated on and the diagnosis of the lesions resulting directly or indirectly from the wound. It is these groups of problems rather than those related to operation which are the more likely to interest the physician.

The Preliminary Treatment. He who sees cases of chest wound when they arrive at the clearing station after a trip of eight miles or more in an ambulance, much of the way over rough roads, will be impressed by the exhausted condition of nearly all having severe, penetrating wounds. He cannot but appreciate their need of rest, quiet and warmth. Consequently, he will limit his first examination to absolute essentials. If the patient has much dyspnea it must be known whether air is being sucked into the chest through an open wound and whether there is extensive edema of the lungs, or a large hemothorax or hemopneumothorax requiring aspiration. External bleeding, if present, must be checked at this time.

The sucking wound should be temporarily closed at once, for these wounds produce severe disturbance of circulation and respiration, and closure of them generally affords marked and prompt relief. A stitch is better than strapping, because it holds more surely and permits of subsequent examination of the region of the wound without letting more air into the chest.

Bleeding can generally be controlled by a pad or pack of gauze tightly strapped in place, and the dressing, as a rule, can be removed a few hours later without causing recurrence of the bleeding. A few cases require to be sent at once to the theater on account of persistent hemorrhage, but probably most of these cases die before reaching the clearing station.

Pulmonary edema generally clears up if the patient is put to bed with the chest slightly raised to facilitate breathing, the bed heated and a dose of morphin, $\frac{1}{6}$ gr., and atropin, $\frac{1}{120}$ gr., administered

subcutaneously. Posture seems to me of great importance. The pillow should be arranged like a wedge, with its apex under the lumbar spine and the thick part of the wedge under the shoulders and head. To raise the head only does little good, and, on the other hand, to set the patient nearly upright is to invite further collapse by handicapping the circulation to brain and medulla. If the patient can breathe as well lying flat with only one thin pillow under his head, he should not be propped up at all. Several times I have seen a patient turn gray and the pulse almost disappear after half an hour of sitting up, but improve again after he had been laid down. When nurses have been told to give bed-rests to chest cases they generally place them nearly vertical instead of at the lowest notch. Pillows are preferable because it is not easy to raise a patient very high with them. If the patient is pale and the pulse weak, neither head nor chest should be elevated if morphin will enable the patient to breathe comfortably lying flat. It is difficult to judge of the effect of morphin and atropin on pulmonary edema in cases newly arrived, because the benefit of rest and warmth is undoubtedly great, and morphin was given all cases that were not soon made comfortable without it.

Pain may be slight, but sometimes it is severe enough to embarrass respiration and to be an important factor in causing exhaustion. Most of the cases that I saw at the clearing station had received from $\frac{1}{4}$ to $\frac{1}{2}$ gr. of morphin at the field ambulance, and many were still under its influence when they came to us. Those whose discomfort or pain persisted after getting to bed and who could not be made comfortable by posture were given a second dose of $\frac{1}{6}$ gr. of morphin, which was generally ample. It is a mistake to use more than is necessary, because morphin tends to leave the patient more irritable than before and less able to bear ensuing inevitable discomfort. Chest cases, in my experience, too, are more irritable than any other class of wounded and more difficult to make comfortable. When severe pain persists in spite of reasonable doses of morphin, it suggests a piece of shell lodged in the pleural cavity or friction between the ends of broken ribs. The treatment for either is early operation. In one such case a hernia of lung was found caught between the ends of a broken rib.

Collapsed patients were sent to the resuscitation ward, where they were warmed and the foot of the bed elevated, provided this could be done without inducing dyspnea. Nearly all of these, on account of the nature of their wounds, were urgently in need of operation to prevent or to control infection. Cases that did not soon begin to improve under the treatment above mentioned seldom became decent operative risks. Solutions of glucose and salts were often used by the continuous drip method per rectum, but it is difficult to know what effect it had, because many cases did well without it.

Transfusion of blood will make some cases operable that would otherwise become heavily infected before an adequate operation could be performed. I believe that cases in which large external loss of blood has occurred should be transfused before any severe operation is undertaken. It is not easy to select these cases because the only reliable evidence, as a rule, is the finding of large amounts of blood in the dressings of the patient on arrival; but if dressings were renewed and hemorrhage stopped at the field ambulance, evidence of hemorrhage is lacking. On the other hand, collapse from shock or from exhaustion simulates conditions resulting from hemorrhage. When the presence of a large hemothorax suggests that loss of blood has been chiefly internal, transfusion seems to me contra-indicated for two reasons: (1) lest it add to existing circulatory embarrassment directly, and (2) lest it induce further internal hemorrhage. In abdominothoracic wounds with intraperitoneal hemorrhage transfusion is not likely to do good until after operation. It is dangerous, I think, whenever dyspnea is marked, whether associated with large hemothorax, pneumothorax, pulmonary edema or massive collapse of the lung.

DIAGNOSIS. The difficulty of diagnosis in some serious cases will be apparent when it is realized that the patient needs rest, that examination fatigues him, that he must be roentgen-rayed before operation, and that he should be in the theater and in condition to stand the operation with the least possible delay.

Moreover, he cannot take a deep breath; his apex impulse is seldom palpable at this time; the anterior portions of the lungs are often hyperresonant; frequently there is subcutaneous emphysema of parts of the chest wall, causing a tympanitic percussion note; in other parts there are wounds; both lungs may be damaged; there may be pulmonary edema, bilateral hemothorax, massive collapse on the unwounded side, and on the wounded side simple hemothorax, pneumothorax, more or less collapse, hemorrhagic infiltration, more or less extensive, or any combination of these.

Displacement of the heart in the *same* direction may be caused by massive collapse on one side, hemothorax on the other, or by both together.

Moreover, wounds which do not penetrate the pleura frequently cause hemoptysis, not rarely hemothorax, and sometimes extensive collapse of the lung.

On the second day after wounding, and subsequently, patients can be examined more easily than on the first day. They breathe more naturally, and the signs, for some reason which I do not understand, seem to be more definite.

Fluoroscopic examinations were made in all cases having retained missiles, and in many others, as an aid to diagnosis of the intrathoracic condition. Sometimes a foreign body which had entered the chest would be found in the abdomen or liver, or the wound of

entrance and the position of the foreign body in the chest might show that it must have injured the diaphragm. The roentgen-ray examinations were made in the standard position with the screen, the patient lying flat on his back on the stretcher with a half-blown air cushion under the head and shoulders. Displacement of the heart was looked for and the shadows were described. The radiologist could distinguish hemothorax, as a rule, without difficulty. With hemothorax of large or moderate size the heart was seen to be displaced toward the opposite side. The diaphragm was visible, as a rule, when the hemothorax was small and sometimes when it was of moderate size. The position of the diaphragm in these cases when seen was regularly reported by Capt. Finzi, R.A.M.C., as being elevated and its movement restricted on the side of the hemothorax. Another radiologist frequently reported the diaphragm depressed and flattened with hemothorax, but I think that the raised position was the more usual. Hemorrhage into the lung along the track of the missile often gave a shadow distinctly visible. Shadows in the opposite lung not due to direct injury were sometimes attributed to more or less extensive collapse of the lung. The condition was spoken of as "contralateral collapse." The shadows were wedge-shaped, the base toward the lateral chest wall and the apex toward the spine. Generally, there was an area of better illumination at the extreme base and in the costodiaphragmatic angle which served to differentiate the condition from hemothorax.

Preliminary Aspiration. In a small proportion of cases in which a large hemothorax, or hemopneumothorax exists it may cause a positive intrathoracic pressure on the affected side with the result that dyspnea renders the patient's condition unsatisfactory for operation. Moreover, opening the chest would lead to a sudden reduction of this pressure, and in cases in which the mediastinal contents are freely movable, might result in added disturbances of circulation or respiration. Therefore, in such cases, it has seemed to me best to aspirate as a preliminary to operation, and to endeavor to leave the intrathoracic pressure at approximately that of the atmosphere, or, in other words, to withdraw only as much as can be easily obtained without suction. To empty the chest so soon after wounding would be to run the risk of recurrent hemorrhage.

By a series of observations of intrathoracic pressure in hemothorax² measured in centimeters of water, it was found that intrathoracic pressure might sometimes be reduced by as much as 12 cm. by the removal of not more than 780 c.c. of fluid. The negative pressure so produced would be suddenly neutralized the moment the chest was opened at operation. This last disadvantage, however, can be overcome in large measure by the use of gas-oxygen anesthesia and a positive pressure of the anesthetic while the chest is

² Shattuck and Welles: Quarterly Jour. Med., April, 1919.

open. Major Geoffrey Marshall, R.A.M.C., when in charge of anesthetics for the Second British Army in 1918, used positive anesthetic pressure for thoracotomy operations with marked success.

POST-OPERATIVE MANAGEMENT. *Post-operative Aspiration.* When, by a radical operation, the hemothorax has been evacuated, bone fragments and foreign body removed and the chest closed, fluid soon begins to collect in the pleural cavity. Its rate of increase is probably determined chiefly by the amount of residual infection. To limit this accumulation and to promote reëxpansion of the lung it became the practice to aspirate once at least after operation. The rule which I followed was to aspirate after twenty-four hours had elapsed and again two days later. In the most favorable cases 200 or 300 c.c. of fluid and some air were obtained at the first tap, and so little fluid at the second that further tapping was superfluous. In all instances a specimen of fluid was sent to the laboratory for aërobic and anaërobic cultivation, so that infection, when present, should be quickly recognized.

Lockwood and Nixon³ reported excellent results in a number of infected chests which had been cleaned out as far as possible by operation, closed and aspirated. In spite of infection demonstrated after operation they aspirated repeatedly instead of resorting to secondary drainage. I have no doubt that their example could be followed to advantage in certain types of cases, but believe that if aspiration is to be relied on to keep an infected chest clear of fluid it is essential to have the use of a portable roentgen-ray apparatus which can be used in the ward. By this means, and by no other, I think, can there be any assurance that all the fluid has been in fact removed. Lockwood and Nixon used such an apparatus and considered it indispensable.

For two days after severe operations morphin was used freely to relieve pain and to check the restlessness of discomfort. Cases doing well did not require its longer continuance.

Pulmonary Edema. Some patients who had been operated on and others who had not were troubled by attacks of dyspnea and wheezing or rattling in the chest associated with light frothy expectoration. The attacks came on sometimes late at night, in other cases in the evening and in still other instances the symptoms began in the daytime.

The mildest attacks were those that came on late at night. The condition in these cases was quickly relieved by a dose of morphin $\frac{1}{6}$ gr., and atropin, $\frac{1}{120}$ to $\frac{1}{100}$ gr., subcutaneously. When the attack began in the evening relief was temporary, and a second dose was required in the course of the night. When frothy expectoration first appeared in the daytime it yielded less readily to drugs, and the edema usually became more marked during the night.

³ British Med. Jour., January 26, 1918, p. 105.

The frothy expectoration occurred in two groups of cases, namely—in the later stages of cases that were more or less infected and in the early stages of severely wounded cases, especially when exhausted by travel. In the later stages the froth was white, but sometimes it was mixed with the purulent sputum of bronchitis. The response to drugs was best when there was no bronchitic sputum and correspondingly less when it predominated. Pulmonary edema coming on in the daytime was a bad prognostic sign.

Among the group of cases in which pulmonary edema appeared early there were some which arrived at the clearing station in this condition. As might be expected so soon after wounding the froth was tinged with blood and was often mixed with thick mucus or blood. In these cases also the result of medication seemed to depend a great deal on whether or not the sputum consisted chiefly of froth or mainly of viscid material and blood.

CASES NOT REQUIRING EARLY OPERATION. These cases consist of two groups, namely—those whose condition is apparently hopeless and those which may be expected to do well without operation.

Some of these last require aspiration for relief of symptoms or to hasten convalescence, and others develop intrathoracic infection, calling for operative interference later. Their special problems are discussed in the paragraphs which follow.

Intrathoracic infection in chest wounds commonly follows penetration of the chest by a large shell fragment. It seldom results from a bullet or shrapnel ball except in the comparatively small number of these cases having extensive bone damage. Early operation is indicated in the cases likely otherwise to become infected. The remainder should not be operated on unless evidence of infection appears later. The important thing is to watch for signs of developing infection and to recognize it promptly if it appears. Nearly all cases of penetrating wounds have enough hemothorax to make it possible to withdraw a sample to be cultured in the laboratory. This should be done for all cases of hemothorax that are to remain in the hospital long enough to get a report.

Fever of a moderate degree is the rule in sterile hemothorax, but after a few days it begins to subside. Case I is an example, but in this case the fever lasted considerably longer than is common in the absence of infection. The two negative reports on the chest fluid and the final subsidence of the fever indicate that if infection was present at all it was inconsiderable. Infection generally begins to give signs on or after the third day, although cultures of chest fluid will often show its existence earlier.

Infection should be suspected when the temperature and pulse do not show a downward tendency after a few days, when the amount of fluid in the chest seems to be increasing, when the patient's condition does not rapidly improve, or when after temporary improvement he becomes abnormally irritable, complains of intrathoracic pain and the temperature begins to rise again.

An early sign of infection to which Capt. Adrian Stokes, of the Royal Army Medical Corps, called my attention is well-marked hemolysis in chest fluids obtained within three days of the wounding. Hemolysis developing later is so common in chest fluids which remain sterile that it has no considerable diagnostic value after the first three days.

Infection with streptococcus causes a rapid increase of fluid in the chest. The infection may develop early or late, and when it comes early may be combined with infection by other organisms. The streptococci found in the chest were of two principal types, hemolytic and non-hemolytic. Both organisms generally caused serious infection, but the hemolytic type seemed to be particularly virulent. The mortality of infected hemothorax following *early* resection of a rib and open drainage is very high, so much so that anything which offers hope of reducing it should be tried. The mortality is lower when the infection does not appear until the end of the first week or later. Open drainage after the first week disturbs the respiration and circulation far less than is the case when it is performed earlier. This can be explained on the supposition that adhesions have formed and the cavity become walled off by a thick layer of fibrin. Certain it is that in these cases of late operation very little air passes back and forth through the drainage tube, whereas in cases of early drainage the reverse is true and the patient can only be made comfortable by preventing the inrush of air during inspiration by applying some kind of valve as a part of the dressing.

Aspiration of Infected Chests. In the summer of 1918 I treated eight or nine cases of early infected hemothorax by daily aspiration for a week before resection was performed. It was hoped in this way to limit the infection to a smaller cavity and to reduce mortality. After each aspiration the patients generally felt more comfortable, and in several cases the pulse and the temperature dropped in the course of a few days to nearly normal, only to rise again later. The attempt to reduce the size of the cavity to be drained was not apparently successful. In some cases the reduction of toxemia was slight and transient, in others marked benefit resulted, but was followed after a few days by recurrence of toxemia. In all cases emaciation developed rapidly. The failure to get all the results hoped for can be attributed to the difficulty of draining completely by aspiration a collection of fluid containing large and increasing amounts of coagulum and having a marked tendency to collect in pockets.

No case of hemolytic streptococcus infection was included in this series. One case had gas-bacillus infection. His condition on admission was such that operation was not then considered. Following aspiration of the chest, little if any walling off took place. Two small transfusions gave temporary benefit and resection was finally performed, but the patient died after about two weeks.

The other cases had non-hemolytic streptococcus. It seemed to me that the marked temporary improvement shown by some of them indicates that aspiration within the first five days followed by open drainage is probably less dangerous than open drainage performed earlier. Operative drainage, I think, should not be delayed as much as a week, but should be performed the moment improvement after aspiration ceases. Control observations by means of a portable roentgen-ray apparatus would have been valuable.

Pneumococcus infections of the pleural cavity tend to die off quickly and some of them can be cured by aspiration alone. The same is true of some cases of staphylococcus infection. Cases of gas-bacillus infection may show very marked symptomatic improvement after aspiration. Unless there is concomitant infection with other organisms it is probably good practice to aspirate them once at least before operation. This should certainly be done if accumulation of gas or a large amount of fluid embarrasses respiration or circulation. The gas bacillus is by no means as virulent in the pleural cavity as it is in the muscles.

Aspiration cannot be relied on for more than temporary relief for cases having large retained fragments of shell plus the cloth and bone fragments usually carried in by them. Early radical operation offers the only hope for these cases. Aspiration as a *cure for infection* should be tried only when the infection develops late, is of a mild type or follows a radical cleansing operation.

A portable roentgen-ray apparatus would add materially to the safety and advantage of this method, because plates could then be taken without fatiguing the patient and it would be possible to determine after aspiration whether all the fluid had been removed.

Hemothorax. For purposes of description, hemothoraces can be divided into three classes: the small, in which the pleural cavity contains not more than 500 c.c. of bloody fluid; the moderate, containing from 500 to 1000 c.c.; and the large, hemothoraces of from 1000 c.c. upward.

The physical signs of a small hemothorax are dulness below the angle of the scapula, with all other signs diminished and more or less ægophony. The ægophony is not pronounced, but, I think, it is the most valuable single sign of fluid in these cases.

So far as I have been able to ascertain from the somewhat conflicting reports of various radiologists the diaphragm is usually high and moves little from the first days after wounding. It was early learned that exploratory tapping to demonstrate the pressure of small hemothoraces was generally successful even when signs were very slight, provided the puncture was made midway between the spine and the posterior axillary line in the interspace lying under the angle of the scapula. To uncover this interspace the hand of the patient was carried to the shoulder of the opposite side. Exploratory taps made lower down frequently failed to show the presence

of fluid. In other words, the fluid in a small hemothorax lies higher than is the case with pleural effusion or the common form of empyema secondary to pneumonia. In the early days of hemothorax it seems improbable that settling out of fibrin or the formation of adhesions in a *sterile* hemothorax could account for failure to obtain fluid lower down.

These observations strengthen the view that the diaphragm in small hemothoraces is generally at a high level. •

The apex impulse of the heart is not notably displaced, but the roentgen ray may show slight displacement away from the fluid, indicating a reduction of negative pressure in the affected side of the chest. Case III is a typical example of small sterile hemothorax.

The hemothorax of moderate size gives physical signs like the small one, but more marked. Cardiac displacement cannot often be demonstrated in the first few days after wounding without putting the patient through a more rigorous examination than seemed ordinarily justifiable or necessary. The apex impulse is often impalpable at this stage. Symptoms in these cases do not render aspiration urgent.

When I began to examine cases of hemothorax I assumed that the changes in the breath sounds over the retracted lung near the upper limit of the fluid would be the same as in the ordinary case of pleural effusion. I expected the breath sounds to be diminished in intensity but typically bronchial in character. It was found, in most cases, however, that their quality was not typically bronchial, but rather more amphoric. They might perhaps have been described as bronchoamphoric, partaking, as they did, of both qualities (Case III). Sometimes they were almost purely amphoric as in typical pneumothorax. Nevertheless, exploratory tapping over the point of greatest intensity of this breathing yielded over and over again fluid only. Neither was air often obtained, as below stated, by aspiration. (See Pneumothorax.)

The intensity of the breath sounds over a hemothorax is almost invariably diminished above and still more diminished or absent below.

Retraction or flattening of the chest-wall below the clavicle in front or below the angle of the scapula behind or at both points was observed in a great many cases of hemothorax examined at the 22d General Hospital. This phenomenon seemed to be less frequent and less marked the first few days after wounding than after a week or more from the date of injury.

This condition associated, as it appeared to be, with a high diaphragm, points in these cases to collapse of the lung over and above that induced by the mere presence of fluid. (See Massive Collapse below.)

That the diaphragm may be depressed, and probably is depressed, as a rule, by large collections of fluid or of fluid and air in the pleural

cavity, seems altogether likely. In such cases, however, the shadow of the hemothorax is so dense that the radiologist cannot locate the diaphragm with certainty.

Aspiration for Hemothorax. Hemothoraces of about 2000 c.c., associated with dyspnea and rapid pulse, were aspirated as soon as possible, with the object of relieving distress, but no attempt was ordinarily made to empty the pleural cavity within the first week after wounding lest recurrence of intrapleural hemorrhage be induced by the production of a high negative intrathoracic pressure. A large hemothorax suggests damage to a large vessel and relatively greater danger of recurrent hemorrhage into the pleural cavity. Case I is, I believe, an example of recurrent hemorrhage.

To aspirate a small sterile hemothorax seems scarcely worth while, and it has seemed to me wiser to do nothing than to aspirate except to relieve symptoms in the first few days after wounding. To disturb intrathoracic conditions at this time is to violate the principle of rest to the injured part, and perhaps to increase the chance of intrapleural infection. (See Case III.)

For hemothoraces of moderate size, in which fever persisted, it was my practice not to aspirate before the end of the first week, by which time the distress consequent upon recent injury to the chest had passed. Fever develops even with sterile hemothoraces. The temperature generally dropped to near normal on the day following aspiration, and the patient often said he could breathe more freely. The purpose was to shorten convalescence by leaving less to be absorbed from the pleural cavity and by reducing fever.

Exploratory tapping was frequently performed as an aid to diagnosis or to obtain a specimen of fluid for aerobic and anaerobic cultivation. This should be done as soon as possible, and by routine, in order to detect infection at an early stage. A negative result does not rule out infection, which may be missed because local, but may later become general in the pleural cavity.

Replacement of fluid by oxygen is advisable if more than 700 c.c. of fluid is to be withdrawn. The removal of larger amounts of fluid causes a marked change of intrathoracic pressure, generally causes cough and pain which interrupt the work, and may, perhaps, favor infection of the pleural cavity or bring on intrapleural hemorrhage.

Oxygen Replacement.—By means of oxygen replacement a very large hemothorax may be evacuated without pain or discomfort. It is good practice, I think, to withdraw 500 c.c. of fluid before beginning to replace, and after that to replace fluid withdrawn with an equal amount of oxygen, allowing it to run in simultaneously. This method is quicker, easier and more comfortable to the patient than alternately to withdraw fluid and put in oxygen (Shattuck and Welles, see footnote 2).

Difficulty occurs when there are small clots in the fluid which repeatedly plug the aspirating needle or when there is massive

clotting of the blood. In other cases the method of Palfrey works extremely well.

Case IV is an example of successful replacement in which Palfrey's apparatus was used.

Hemopneumothorax. If cases of hemopneumothorax were numerous I generally failed to recognize them by physical examination, aspiration or by roentgen rays. I cannot but believe, however, that many more cases existed than were recognized. That small amounts of air should not have been found by roentgen rays is not surprising, because most of the screening was done with the patient lying on his back. To have done otherwise would have exposed the patients to unnecessary distress and fatigue, and the greater amount of time required for such an examination would have seriously interfered with other urgent demands on the radiologist.

Large hemothoraces requiring early aspiration for relief of symptoms not infrequently yielded considerable amounts of air as well as fluid. In less urgent cases aspiration was postponed for a week or more and small quantities of air, if originally present, might have been absorbed in the meantime. Whatever the reason, air was seldom obtained when aspirating small or medium-sized hemothoraces.

It has been believed by some that a *small amount of air* associated with a hemothorax will cause much greater cardiac displacement than would result from a similar volume of fluid alone. I hesitate to believe this failing a rational explanation for a phenomenon which would seem to contravene physical laws. If pressure in the air were greater than that in the fluid, would not the fluid float on the air? If air-pressure is not greater than fluid-pressure, why should it displace the heart more?

Massive Collapse of the Lung. The occurrence in cases of chest-wounds of collapse of considerable portions of lung tissue for no known cause is a most interesting fact (Case II).

This subject has been so well handled by Sir John Rose Bradford⁴ who was one of the British Medical consultants in France, that I shall not discuss it in detail. The collapse may occur in the wounded lung, in the uninjured lung or in both lungs. Apparently, it most often affects only a part of one lobe, but in some cases it is very extensive, and it then causes very marked cardiac displacement by drawing the heart away from the opposite side of the chest.

If, for example, a bullet has passed through the left side of the chest without causing much damage, but leaving behind a small hemothorax one expects to find no marked cardiac displacement and no abnormal signs in the right chest unless extensive collapse has occurred in the right lung, when the cardiac impulse will be found near the right nipple; the right side of the chest will be

⁴ Quarterly Jour. Med., xii, 127.

immobile and retracted; there will be extensive dulness; the breath sounds may be bronchial or absent; and the roentgen rays will show a shadow over the right side of the chest, a high, immobile diaphragm, and the dorsal portions of the ribs will form a more acute angle with the spine on the right than on the left.

Cases of such extensive collapse are easy to recognize, but they are rare. Lesser degrees of collapse are probably common but difficult to diagnose with certainty. The possible presence of more or less collapse in either lung in any case of chest wound renders interpretation of physical signs difficult and uncertain. A common error is to mistake the collapse for pneumonia or for fluid. The position of the apex impulse is the key.

CHEST WOUNDS AT THE BASE. The problems at the base differ from those at the clearing station mainly from the fact that patients arrive later, that most of the bad cases have been eliminated by death or improved by operation, and that, as a rule, the patients arrive too late for radical operation, designed to prevent infection.

What is most needed is to combat existing infections of the parietes or intrathoracic structures, and to keep a sharp lookout for complications, and for infections which may develop late.

Pulmonary edema is sometimes induced by the journey and develops at night in some infected cases. The treatment has been described above.

Massive collapse is seen at the base as well as in the zone of the armies.

The questions relating to sterile hemothorax can be most advantageously studied at the base.

SUMMARY. Under the war conditions met with a physician could render valuable service either at an advanced operating center or at a hospital in the rear by coöperating with the surgeon who did the chest operations, or even by becoming responsible for the treatment of all cases of chest-wound, whether operated on or not. The selection of cases for operation, their preliminary treatment and after-care were left mainly in the hands of the physician after he had learned to select the types of cases which operation could be expected to help.

When urgency of work does not require the constant presence of the surgeon in the operating room, however, he will do well to take personal charge of the post-operative cases himself, and should confer with the physician whenever doubt arises as to the best course of treatment to pursue either before or after operation.

There are many points of technic still to be worked out regarding the best methods of operating and the care of post-operative chest cases, which the surgeon can never appreciate unless he himself follows closely the cases he has operated on.

Close coöperation between one physician and one surgeon is essential to the best results and a strong nursing staff is absolutely necessary if treatment is to be satisfactorily carried out.

The management of cases not requiring operation, the diagnosis of intrathoracic lesions and the treatment of some of the most serious symptoms is essentially medical work.

Aspiration may be useful (a) as a preliminary to operation or to relieve symptoms when a large hemothorax or hemopneumothorax exists; (b) it should be performed after thoracotomy and closure of the chest; (c) infected hemothoraces should, in some cases, be aspirated for several days before open drainage is resorted to. A few will recover by aspiration alone.

Sterile hemothoraces, probably, should not be aspirated, unless causing symptoms, until a week or more after wounding, lest infection be drawn into the pleural cavity.

Replacement with oxygen is useful in cases of certain types.

It is a pleasure to thank Surgeon-General Sir John Rose Bradford and Colonel A. B. Soltau, of the British Medical Service, for helpful advice and information.

CASE I.—J., admitted to the casualty clearing station October 4, 1917, in the morning. Wounded probably on the day before. On arrival the patient was collapsed. He had multiple small wounds of the left shoulder and a slightly larger wound in the lower left axilla. The wounds looked as if produced by a shell or grenade, but the fragment which struck the lower axilla was probably the only one to penetrate the chest. None of the wounds were severe. The signs indicated a very large hemothorax. The patient was kept under morphin for the first twenty-four hours. After that he was comfortable and had little dyspnea.

A roentgen-ray examination of a few days later showed the heart displaced considerably to the right and a dense shadow over the left chest. The left diaphragm could not be located and showed no sign of movement. An irregular shell fragment, about 1.5 cm. in greatest diameter, was seen near the root of the left lung.

October 12. Aspiration was postponed in this case until the ninth day because symptoms did not require it. About 1000 c.c. of dark colored bloody fluid was withdrawn. It ran in a steady stream without requiring suction. No cough or distress resulted. Immediately after the aspiration, dulness was diminished on the left and the cardiac displacement seemed to have diminished.

October 13. The signs on this day indicated no less fluid in the chest than before aspiration was performed. By a second aspiration about 1000 c.c. of fluid like the first was again withdrawn. It flowed in an even stream as before and its withdrawal was accompanied by none of the discomfort usually incident to expansion of the lung when this quantity of fluid is removed.

October 14. The patient looked decidedly paler than he had looked before the first aspiration and the chest signs still indicated the presence of a large amount of fluid.

It was believed that the chest had filled up again and that hemorrhage had probably played a considerable part in replacing the

The other cases had non-hemolytic streptococcus. It seemed to me that the marked temporary improvement shown by some of them indicates that aspiration within the first five days followed by open drainage is probably less dangerous than open drainage performed earlier. Operative drainage, I think, should not be delayed as much as a week, but should be performed the moment improvement after aspiration ceases. Control observations by means of a portable roentgen-ray apparatus would have been valuable.

Pneumococcus infections of the pleural cavity tend to die off quickly and some of them can be cured by aspiration alone. The same is true of some cases of staphylococcus infection. Cases of gas-bacillus infection may show very marked symptomatic improvement after aspiration. Unless there is concomitant infection with other organisms it is probably good practice to aspirate them once at least before operation. This should certainly be done if accumulation of gas or a large amount of fluid embarrasses respiration or circulation. The gas bacillus is by no means as virulent in the pleural cavity as it is in the muscles.

Aspiration cannot be relied on for more than temporary relief for cases having large retained fragments of shell plus the cloth and bone fragments usually carried in by them. Early radical operation offers the only hope for these cases. Aspiration as a *cure for infection* should be tried only when the infection develops late, is of a mild type or follows a radical cleansing operation.

A portable roentgen-ray apparatus would add materially to the safety and advantage of this method, because plates could then be taken without fatiguing the patient and it would be possible to determine after aspiration whether all the fluid had been removed.

Hemothorax. For purposes of description, hemothoraces can be divided into three classes: the small, in which the pleural cavity contains not more than 500 c.c. of bloody fluid; the moderate, containing from 500 to 1000 c.c.; and the large, hemothoraces of from 1000 c.c. upward.

The physical signs of a small hemothorax are dulness below the angle of the scapula, with all other signs diminished and more or less ægophony. The ægophony is not pronounced, but, I think, it is the most valuable single sign of fluid in these cases.

So far as I have been able to ascertain from the somewhat conflicting reports of various radiologists the diaphragm is usually high and moves little from the first days after wounding. It was early learned that exploratory tapping to demonstrate the pressure of small hemothoraces was generally successful even when signs were very slight, provided the puncture was made midway between the spine and the posterior axillary line in the interspace lying under the angle of the scapula. To uncover this interspace the hand of the patient was carried to the shoulder of the opposite side. Exploratory taps made lower down frequently failed to show the presence

of fluid. In other words, the fluid in a small hemothorax lies higher than is the case with pleural effusion or the common form of empyema secondary to pneumonia. In the early days of hemothorax it seems improbable that settling out of fibrin or the formation of adhesions in a *sterile* hemothorax could account for failure to obtain fluid lower down.

These observations strengthen the view that the diaphragm in small hemothoraces is generally at a high level. •

The apex impulse of the heart is not notably displaced, but the roentgen ray may show slight displacement away from the fluid, indicating a reduction of negative pressure in the affected side of the chest. Case III is a typical example of small sterile hemothorax.

The hemothorax of moderate size gives physical signs like the small one, but more marked. Cardiac displacement cannot often be demonstrated in the first few days after wounding without putting the patient through a more rigorous examination than seemed ordinarily justifiable or necessary. The apex impulse is often impalpable at this stage. Symptoms in these cases do not render aspiration urgent.

When I began to examine cases of hemothorax I assumed that the changes in the breath sounds over the retracted lung near the upper limit of the fluid would be the same as in the ordinary case of pleural effusion. I expected the breath sounds to be diminished in intensity but typically bronchial in character. It was found, in most cases, however, that their quality was not typically bronchial, but rather more amphoric. They might perhaps have been described as bronchoamphoric, partaking, as they did, of both qualities (Case III). Sometimes they were almost purely amphoric as in typical pneumothorax. Nevertheless, exploratory tapping over the point of greatest intensity of this breathing yielded over and over again fluid only. Neither was air often obtained, as below stated, by aspiration. (See Pneumothorax.)

The intensity of the breath sounds over a hemothorax is almost invariably diminished above and still more diminished or absent below.

Retraction or flattening of the chest-wall below the clavicle in front or below the angle of the scapula behind or at both points was observed in a great many cases of hemothorax examined at the 22d General Hospital. This phenomenon seemed to be less frequent and less marked the first few days after wounding than after a week or more from the date of injury.

This condition associated, as it appeared to be, with a high diaphragm, points in these cases to collapse of the lung over and above that induced by the mere presence of fluid. (See Massive Collapse below.)

That the diaphragm may be depressed, and probably is depressed, as a rule, by large collections of fluid or of fluid and air in the pleural

cavity, seems altogether likely. In such cases, however, the shadow of the hemothorax is so dense that the radiologist cannot locate the diaphragm with certainty.

Aspiration for Hemothorax. Hemothoraces of about 2000 c.c., associated with dyspnea and rapid pulse, were aspirated as soon as possible, with the object of relieving distress, but no attempt was ordinarily made to empty the pleural cavity within the first week after wounding lest recurrence of intrapleural hemorrhage be induced by the production of a high negative intrathoracic pressure. A large hemothorax suggests damage to a large vessel and relatively greater danger of recurrent hemorrhage into the pleural cavity. Case I is, I believe, an example of recurrent hemorrhage.

To aspirate a small sterile hemothorax seems scarcely worth while, and it has seemed to me wiser to do nothing than to aspirate except to relieve symptoms in the first few days after wounding. To disturb intrathoracic conditions at this time is to violate the principle of rest to the injured part, and perhaps to increase the chance of intrapleural infection. (See Case III.)

For hemothoraces of moderate size, in which fever persisted, it was my practice not to aspirate before the end of the first week, by which time the distress consequent upon recent injury to the chest had passed. Fever develops even with sterile hemothoraces. The temperature generally dropped to near normal on the day following aspiration, and the patient often said he could breathe more freely. The purpose was to shorten convalescence by leaving less to be absorbed from the pleural cavity and by reducing fever.

Exploratory tapping was frequently performed as an aid to diagnosis or to obtain a specimen of fluid for aerobic and anaerobic cultivation. This should be done as soon as possible, and by routine, in order to detect infection at an early stage. A negative result does not rule out infection, which may be missed because local, but may later become general in the pleural cavity.

Replacement of fluid by oxygen is advisable if more than 700 c.c. of fluid is to be withdrawn. The removal of larger amounts of fluid causes a marked change of intrathoracic pressure, generally causes cough and pain which interrupt the work, and may, perhaps, favor infection of the pleural cavity or bring on intrapleural hemorrhage.

Oxygen Replacement.—By means of oxygen replacement a very large hemothorax may be evacuated without pain or discomfort. It is good practice, I think, to withdraw 500 c.c. of fluid before beginning to replace, and after that to replace fluid withdrawn with an equal amount of oxygen, allowing it to run in simultaneously. This method is quicker, easier and more comfortable to the patient than alternately to withdraw fluid and put in oxygen (Shattuck and Welles, see footnote 2).

Difficulty occurs when there are small clots in the fluid which repeatedly plug the aspirating needle or when there is massive

clotting of the blood. In other cases the method of Palfrey works extremely well.

Case IV is an example of successful replacement in which Palfrey's apparatus was used.

Hemopneumothorax. If cases of hemopneumothorax were numerous I generally failed to recognize them by physical examination, aspiration or by roentgen rays. I cannot but believe, however, that many more cases existed than were recognized. That small amounts of air should not have been found by roentgen rays is not surprising, because most of the screening was done with the patient lying on his back. To have done otherwise would have exposed the patients to unnecessary distress and fatigue, and the greater amount of time required for such an examination would have seriously interfered with other urgent demands on the radiologist.

Large hemothoraces requiring early aspiration for relief of symptoms not infrequently yielded considerable amounts of air as well as fluid. In less urgent cases aspiration was postponed for a week or more and small quantities of air, if originally present, might have been absorbed in the meantime. Whatever the reason, air was seldom obtained when aspirating small or medium-sized hemothoraces.

It has been believed by some that a *small amount of air* associated with a hemothorax will cause much greater cardiac displacement than would result from a similar volume of fluid alone. I hesitate to believe this failing a rational explanation for a phenomenon which would seem to contravene physical laws. If pressure in the air were greater than that in the fluid, would not the fluid float on the air? If air-pressure is not greater than fluid-pressure, why should it displace the heart more?

Massive Collapse of the Lung. The occurrence in cases of chest-wounds of collapse of considerable portions of lung tissue for no known cause is a most interesting fact (Case II).

This subject has been so well handled by Sir John Rose Bradford⁴ who was one of the British Medical consultants in France, that I shall not discuss it in detail. The collapse may occur in the wounded lung, in the uninjured lung or in both lungs. Apparently, it most often affects only a part of one lobe, but in some cases it is very extensive, and it then causes very marked cardiac displacement by drawing the heart away from the opposite side of the chest.

If, for example, a bullet has passed through the left side of the chest without causing much damage, but leaving behind a small hemothorax one expects to find no marked cardiac displacement and no abnormal signs in the right chest unless extensive collapse has occurred in the right lung, when the cardiac impulse will be found near the right nipple; the right side of the chest will be

⁴ Quarterly Jour. Med., xii, 127.

immobile and retracted; there will be extensive dulness; the breath sounds may be bronchial or absent; and the roentgen rays will show a shadow over the right side of the chest, a high, immobile diaphragm, and the dorsal portions of the ribs will form a more acute angle with the spine on the right than on the left.

Cases of such extensive collapse are easy to recognize, but they are rare. Lesser degrees of collapse are probably common but difficult to diagnose with certainty. The possible presence of more or less collapse in either lung in any case of chest wound renders interpretation of physical signs difficult and uncertain. A common error is to mistake the collapse for pneumonia or for fluid. The position of the apex impulse is the key.

CHEST WOUNDS AT THE BASE. The problems at the base differ from those at the clearing station mainly from the fact that patients arrive later, that most of the bad cases have been eliminated by death or improved by operation, and that, as a rule, the patients arrive too late for radical operation, designed to prevent infection.

What is most needed is to combat existing infections of the parietes or intrathoracic structures, and to keep a sharp lookout for complications, and for infections which may develop late.

Pulmonary edema is sometimes induced by the journey and develops at night in some infected cases. The treatment has been described above.

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October 14. The patient looked decidedly paler than he had looked before the first aspiration and the chest signs still indicated the presence of a large amount of fluid.

It was believed that the chest had filled up again and that hemorrhage had probably played a considerable part in replacing the

fluid. Against this is the fact that the pulse-rate as shown on the appended chart did not change. In favor of hemorrhage is the lack of signs of expansion of the lung while the aspiration was in progress, the absence of respiratory movement of the injured lung shown by the steady flow of the fluid, the increased pallor of the patient, the unchanged color of the fluid at the second aspiration showing that

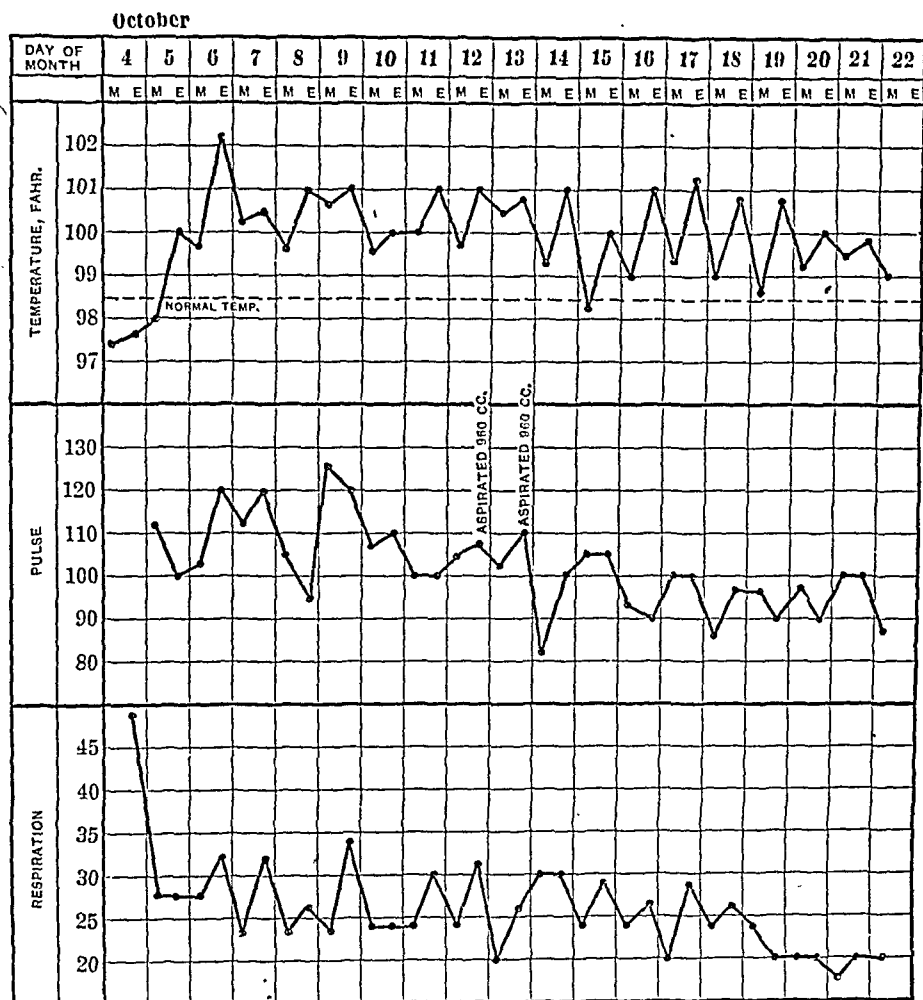


FIG. 1.—Case I. Large hemothorax aspirated on the ninth and tenth days after wounding. Hemorrhage into the pleural cavity apparently recurred on both occasions.

it still contained a like proportion of blood, and the absence of evidence of infection, as shown by the gradual fall of temperature and pulse to near normal and two negative reports on specimens of chest-fluid cultured in the laboratory. Reaccumulation of fluid to a marked degree after aspiration of a hemothorax generally indicates infection, but the fluid poured out in these cases is serous and dilutes the remaining blood, so that the resulting mixture is lighter in color.

CASE II.—M., admitted to 22d General Hospital, April 27, 1917.

History. Wounded on April 23, four days ago, probably by machine-gun bullets, one of which passed through the left arm near the elbow and another through the lower *left* chest near the axillary side. He spit up no blood after being wounded or at any other time. Shortness of breath came on soon after wounding, preventing him from walking.

Physical Examination. Wounds small and clean. Bone damage slight.

Heart. Dulness mainly to *right* of sternum. Impulse distinctly felt above the *right* nipple.

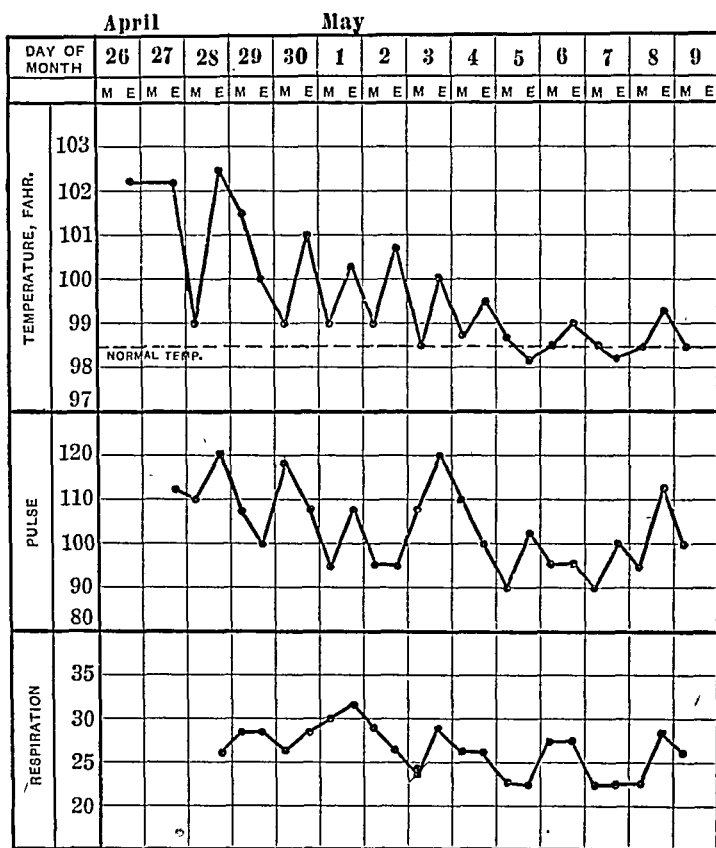


FIG. 2.—Case II. Massive contralateral collapse.

Chest. Below *right* clavicle percussion note tympanitic and breath sounds amphoric rather than bronchial. Below this on the right and in the right axilla there is slight dulness, breath sounds diminished and rather amphoric in quality.

The *right* back showed slight dulness from mid-scapula to base. Tactile fremitus was absent over this dull area. The breath sounds were amphoric in quality, loud above and faint below.

The *left* chest showed no dulness, and no modification of breath sounds was observed.

April 30. The heart impulse is now felt one inch within the *left* nipple. Heart dulness still increased to right.

Below the angle of the *right* scapula definite dulness persists. At the right base the dulness has a tympanitic quality.

May 1. Roentgen-ray report: "Left chest apparently normal. Lower half of right chest somewhat cloudy. Diaphragmatic line obliterated. Dense shadow up to sixth intercostal space. Apex of lung appears normal. Heart normal in size, slightly displaced to *left*." (?) (Probably this is an error or should read right.)

May 2. Motion of chest wall about equal on both sides; no retraction of chest wall. Dulness persists as on April 30.

Heart nearly in the normal position.

Impulse felt one inch within the *left* nipple.

May 4. Exploratory tap below angle of right scapula; nothing obtained.

May 9. Evacuated to England in good condition.

NOTE.—The observations above recorded were made before collapse had been recognized by the writer. They are, therefore, not as complete as they should be. The signs described are typical of collapse and can best be explained by that diagnosis. The fever was probably caused in part if not wholly by slight infection of the wounds. A loose fragment of bone was removed from the dressing on the back on April 30.

CASE III.—R., admitted to 22d General Hospital July 7, 1916.

History. Wounded July 1, probably by a bullet which entered in the upper left axilla and passed out below the angle of the left scapula. Walked six or seven miles, he thinks, after being wounded. Has had severe cough from the beginning and raised a good deal of blood at first. Now raises little, but sputum is occasionally bloody. Has much dry cough.

Physical Examination. Tongue heavily coated.

Heart. Negative and apparently not displaced.

Lungs. Entire front of *left* chest is hyperresonant. Breath sounds increased in front on both sides, more on right than on left. Quality of breath sounds normal. Slight dulness at base of left axilla and in left back below angle of scapula. Over the dull area in the back tactile fremitus is absent. In this area the voice sounds are diminished and show ægophony. In a small area between the wound and the spine the breath sounds are more amphoric than bronchial. Below this they are faint.

Castor oil was prescribed.

July 8. A small hemorrhage from wound in back during the night.

July 11. Wound in axilla healed. The one in back nearly so. Few rales heard at left back. Below angle of scapula on left slight dulness persists. Tactile fremitus diminished. Breath sounds amphoric. General condition much better.

July 15. A few rales at the left base behind. Breath sounds louder and more vesicular. Voice sounds still slightly ægophonic. Front of the chest negative. Slight pain over lower ribs in front.

July 18. Dulness persists but breath sounds are louder and extend to base. They are bronchovesicular in quality.

There is still pain on cough over left lower ribs in front. The wounds are healed and the patient looks very well.

Marked for evacuation to England as a walking patient.

NOTE.—This is a typical case of small sterile hemothorax. The fever may perhaps be due to slight infection of the wounds or perhaps to the hemothorax itself. Initial fever is the rule in such cases even when there is no demonstrable infection of the hemothorax.

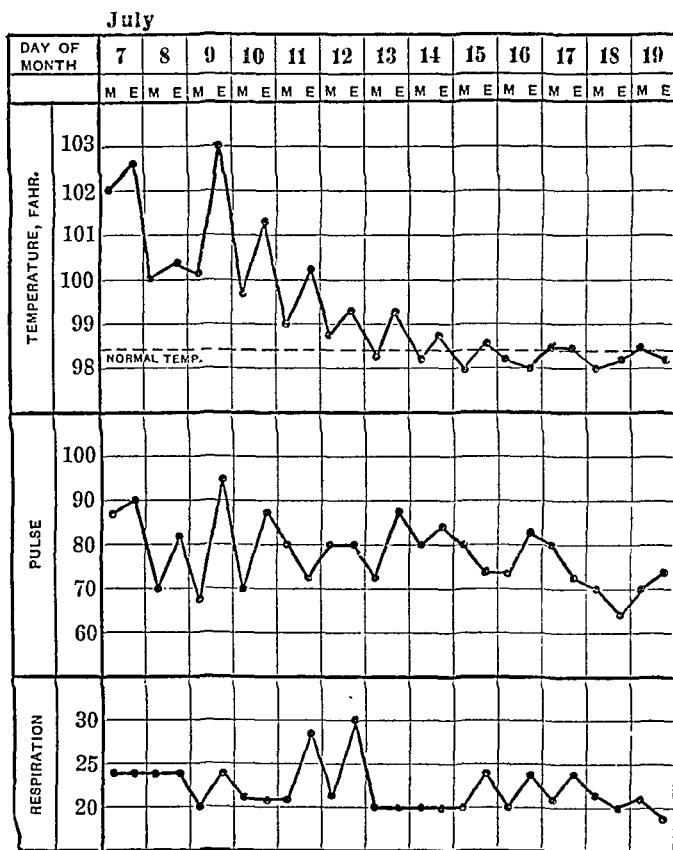


FIG. 3.—Case III. Small sterile hemothorax.

CASE IV.—Notes received with the patient from the casualty clearing station: W., "shrapnel wound of neck. Wounded June 17, 1917. Roentgen rays show foreign body lying in posterior mediastinum. Hemothorax, fluid sterile.

June 30. Aspiration attempted but very little fluid obtained. General condition much improved. Temperature 101° to 102° until June 20, gradually falling after that to normal. Normal after June 27."

July 3. Admitted to 22d General Hospital.

Physical Examination July 3. Apex impulse not visible or palpable. Cardiac dulness considerably increased to right of sternum. Sounds best heard in median line and not heard in nipple line.

Dulness in left chest from third rib in front, from top of axilla

and from spine of scapula to base. The lower part of the chest is flat to percussion. Tactile fremitus diminished above and absent below. Breath sounds are distant, bronchial above and absent below. Aëgophony is marked above and diminished below. Right chest negative.

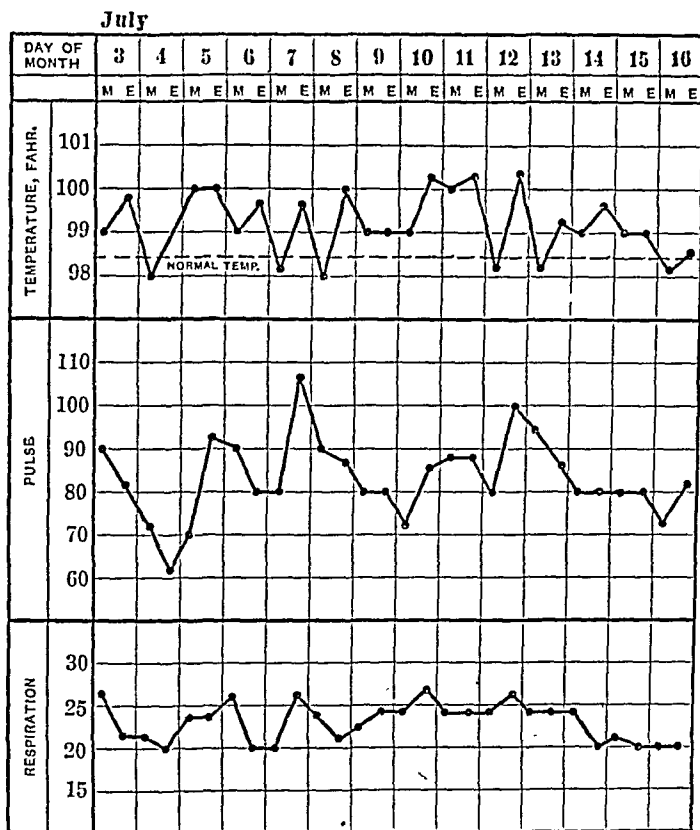


FIG. 4.—Case IV. Aspiration of a hemothorax and replacement by a nearly equal amount of oxygen showing maintenance of intrathoracic pressure almost unchanged.

July 4. Aspirated from left back 1700 c.c. of bloody fluid. Simultaneously 1600 c.c. of oxygen at atmospheric pressure was put in.

The intrathoracic pressure measurements made with a water manometer were as follows:

Before aspirating	{	Expiration	+ 3 cm.
		Inspiration	atmospheric
After aspirating	{	Expiratory	+ 2 cm.
		Inspiratory	0 (or at)

Reduction of inspiratory pressure = 0.

The following measurements from the case of C. serve for comparison. Aspirated 800 c.c. bloody fluid plus an unknown amount of air.

Before aspirating	{	Expiration	+ 3 cm.
		Inspiration	- 2 cm.
After aspirating	{	Expiration	- 2 cm.
		Inspiration	- 14 cm.

Reduction of inspiratory pressure = 12 cm. of water.

THE HEART IN BRONCHOPNEUMONIA: OBSERVATIONS ON THE ACTIVITY OF THE HEART AND ITS RESPONSE TO DIGITALIS MADE DURING THE RECENT EPIDEMIC.

BY T. STUART HART, M.A., M.D.,

VISITING PHYSICIAN TO THE PRESBYTERIAN HOSPITAL, NEW YORK; ASSISTANT PROFESSOR OF CLINICAL MEDICINE, COLUMBIA UNIVERSITY.

DURING the recent epidemic of the so-called influenza in New York as elsewhere the hospital facilities were taxed to the limit. To assume its share in this emergency the Presbyterian Hospital assigned for this purpose 130 beds. These were thus occupied during the months of October and November, with the number gradually diminishing toward the spring. These in combination with a large number seen in consultation with physicians in private practice have given us an opportunity to formulate our impressions on a considerable group of cases.

The present presentation is concerned only with the condition of the adult heart in this epidemic and the manner in which it is affected by digitalis in those who developed bronchopneumonia.

The outstanding features of the typical cases of pneumonia as we have seen them are:

1. The bluish-red pharynx without exudate.
2. The substernal distress associated with the cough.
3. Expectoration copious, mucopurulent and blood-streaked.
4. The absence of evidence of pleurisy.
5. The leukopenia.
6. A bluish-red cyanosis of the skin and mucous membranes out of proportion to the extent of the pulmonary involvement as evidenced by the physical signs or the radiographic plates.
7. The insidious development of the physical signs of consolidation in patches and a change to a bronchial quality of voice and breathing which may appear only after some days or may never become evident during the whole course of the disease.
8. The respiration always accelerated but rarely above 40, except in the cases with a fatal outcome.
9. Fever, usually continuous at a level somewhere between 103° and 105° , sometimes quite irregular, with marked remission, lasting from five to fourteen days, occasionally longer and terminating in those who recover by a drop to the normal, which occupies a period of from twelve to forty-eight hours.
10. Heart-rate always somewhat accelerated, 90 to 110, but as compared with the temperature nearly always relatively slow. In the fatal cases the pulse-rate sometimes gradually becomes more rapid, but, as a rule, there is only marked acceleration in the terminal hours.

11. Heart action regular, sounds of good quality and unchanged except when the consolidation is very extensive, when the pulmonic second sound may be accentuated. Murmurs do not develop. No evidence of engorgement of the right heart.

How IS THE HEART AFFECTED IN THESE CASES? It appears to me that in the majority of these patients the heart does its work remarkably well. The cardiac activity seems to be very similar to the conditions which we observe in uncomplicated typhoid fever. We have (Fig. 1) a relatively slow pulse-rate, a low blood-pressure, both systolic and diastolic, with a fairly good pulse-pressure, a normal rhythm which rarely becomes irregular. I have observed extrasystoles on a few occasions, but not once have I found the development of complete irregularity. The heart sounds are of good quality and murmurs rarely develop. Undoubtedly the marked cyanosis has suggested the thought that the right heart

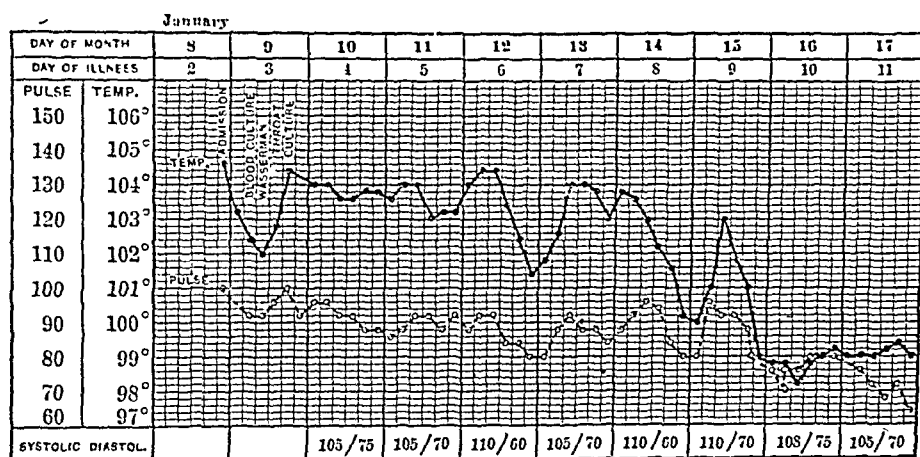


FIG. 1.—Severe uncomplicated bronchopneumonia; recovery. Relatively slow heart-rate; no digitalis administered.

was failing, but if one observes his patients closely he will rarely find other signs to corroborate this point of view. There is no increase in cardiac dullness to the right, no marked epigastric pulsation, no stasis, no exceptional pulsation or distention of the veins discharging into the right auricle. The cyanosis which is so prominent a feature must be explained on grounds other than insufficiency of the right heart. I am personally convinced that the ordinary cause of death is not heart failure. The heart usually preserves its efficiency up to a few hours before the termination, and then only gives way against overwhelming odds (Fig. 2).

The postmortem material which we have been able to study has been regrettably meager, but the few uncomplicated cases in which the heart was carefully studied by Dr. A. A. Eggstein showed only a moderate degree of myocardial degeneration and failed to lend weight to the view that death was due primarily to myo-

cardial insufficiency. A number of our cases died with evidence of pulmonary edema, but even in these the heart seemed to be performing its part with reasonable efficiency.

The fatal termination presented the picture of an overwhelming toxemia. As evidence of this may be cited the extreme cyanosis, the leukopenia, the diminished coagulability of the blood, the fever, the delirium which so frequently develops in the severe cases and in the less severe that are protracted, and the great mortality in pregnant women. The mechanism of the action of the toxins and the tissues most vitally concerned have occupied our thought, and some of our studies have been directed to the solution of this problem, but thus far with inconclusive results. Certain of the phenomena point to a defect in the capillary wall as an important element; others suggest fundamental alterations in the elements of the blood. Incidentally, it may be stated that

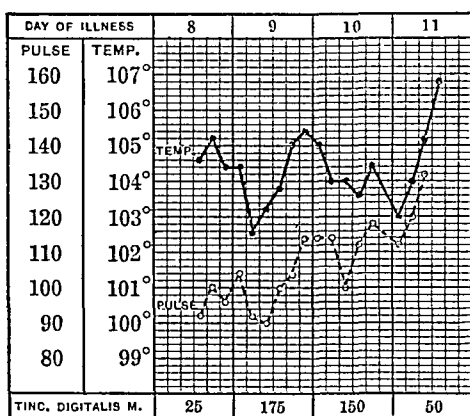


FIG. 2.—Fatal case of uncomplicated bronchopneumonia, showing a relatively slow heart-rate, becoming rapid toward the termination in spite of efficient digitalization.

a number of observations on the carbon dioxide content of the blood showed this to be normal in every instance. This would indicate that the cyanosis is not due to a condition of acidosis.

This view, that the fatal termination in these cases is due to causes other than cardiac failure, is reinforced by the reports of a number of competent pathologists and clinicians. Symmers¹ says: "Both the naked-eye and microscopic appearances of the heart muscle fibers, however, are in the majority of instances indicative of a surprisingly excellent state of preservation. Cloudy swelling, in my experience, is exceptional." Lyon² reports from the Walter Reed Hospital: "In the entire series the heart showed no evident pathological changes." Lamb and Brannin³ in reviewing the epidemic at Camp Cody comment as follows: "Gross changes in the heart or pericardium were not encountered. We found no

¹ Jour. Am. Med. Assn., 1918, lxxi, 1485.

² Ibid., lxxii, 927.

³ Ibid., p., 1060.

evidences of dilatation on either side; the muscle was firm; the ventricles, usually contracted, contained a small amount of dark, semi-clotted blood. The "chicken-fat" clots, often observed in pneumonia and slow death, were not found." Brem, Bolling and Casper⁴ in their report from Camp Freeman say: "The pulse-rate was slow in proportion to the fever and the blood-pressure was low, the systolic pressure frequently being 100 and the diastolic pressure from 40 to 50. The pulse-pressure was good and there were no signs of cardiac insufficiency except in the fatal cases after the onset of respiratory insufficiency and shortly before the end. The danger never appeared to arise from the effect of the infection on the cardiovascular mechanism."

The observations of Synott and Clark⁵ gleaned from experiences at Camp Dix were as follows: "The outstanding feature of the disease was the extreme toxemia noted in the serious cases. . . . Very often the cyanosis came on suddenly in patients who had been doing well. It was not due to cardiac dilatation. The pulse was often slow, full and regular in such cases, and remained so, with a rate under 100 almost until death. The disparity between temperatures and pulse was striking."

DIGITALIS. We made an attempt to determine the action and value of digitalis in these hearts. For this purpose two preparations only were used. A tincture made by the hospital pharmacist, and which has proved potent and efficient clinically both in the course of these patients and upon other patients not of this series which were being treated at the same time in this institution, and "digifolin" (Ciba) in ampules, a solution of digitoxin and digitalin, which proved to be an active preparation, well adapted for intravenous use; the latter preparation was not only found active by clinical observation, but was also standardized by the frog method for us by Dr. Lieb, in the laboratory of experimental pharmacology of the College of Physicians and Surgeons. The tincture was used only by mouth and digifolin only intravenously. In a considerable number of cases the efficiency of our digitalis and evidence of a dosage sufficiently large to modify the activity of the heart under observation was secured by electrocardiographic records. These showed a prolongation of the *P-R* interval, changes in the contour of the *T*-wave⁶ and occasionally a partial auriculoventricular block, conclusive proof that we were effectively digitalizing the myocardium (Figs. 5, 6, 7, 8, 9, 10 and 11).

The routine method adopted in the hospital was to begin the administration of digitalis as soon as the diagnosis of pneumonia was reasonably sure. There was given of the tincture 25 minims every four hours for six doses, which was then reduced to 15 minims

⁴ Jour. Am. Med. Assn., 1918, lxxi, 2139.

⁵ Ibid., p. 1817.

⁶ Cohn, Fraser and Jamieson: Jour. Exp. Med., 1915, xxi, 593.

every eight hours, and continued, with modification according to the individual indications, throughout the course of the disease. Patients who developed symptoms of toxemia very rapidly or who were found in this condition on admission were frequently given 15 to 30 minims of digifolin intravenously, and this was repeated every four hours up to three or four doses, after which time the tincture was usually substituted. We feel that our dosage was sufficient to digitalize the heart in all cases, and this was conclusively proved in those from whom electrocardiographic records were secured.

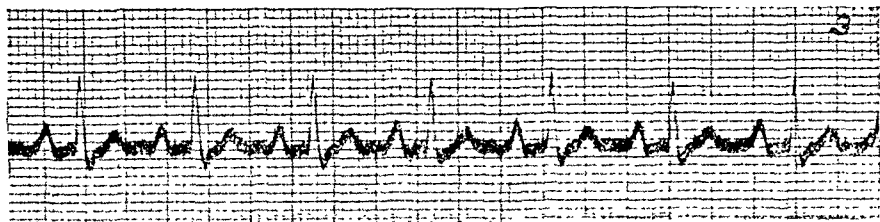


FIG. 3.—Sixth day of disease, after tincture of digitalis 150 minims. Rate 107.
 $P-R = 0.19$ second.

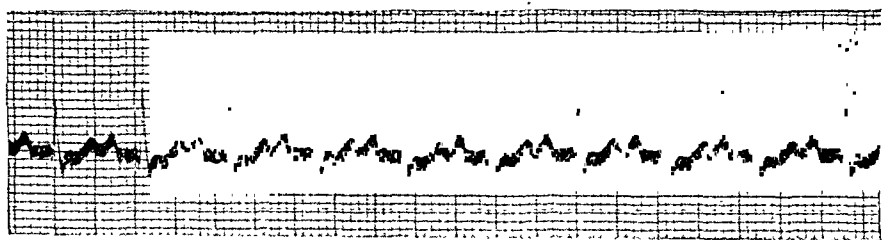


FIG. 4.—Eighth day of disease, after tincture of digitalis 225 minims. Rate 136.
 $P-R = 0.20$ second. Note change in T wave.

FIGS. 3 and 4.—Case of bronchopneumonia terminating fatally on the tenth day of the disease. Admitted on the fourth day with a heart-rate of 104. The rate continued to increase in spite of efficient digitalization and reached 160 twenty-four hours before death.

For the sake of comparison and control a considerable number of cases were from time to time selected at random and treated by methods identical in all respects, except that to these no digitalis was administered.

The results of our observations may be summarized by saying that absolutely no difference in the course of the disease could be observed in the two series. The hearts of those patients treated without digitalis and those to whom it was given behaved in a similar manner, except that the electrocardiograms of those receiving digitalis showed the characteristic changes, and in two instances an arrhythmia developed which proved to be due to a condition of partial heart block (Figs. 6, 7, 8, 10, 11 and 12). The patients to whom digitalis was given ran their course without a change in the pulse-rate which could in any way be attributed to the

drug. Some held a rate below 100 throughout their course, others which had a more rapid rate failed to respond by diminished rate to increasing doses of the drug (Figs. 2, 3 and 4). The terminal

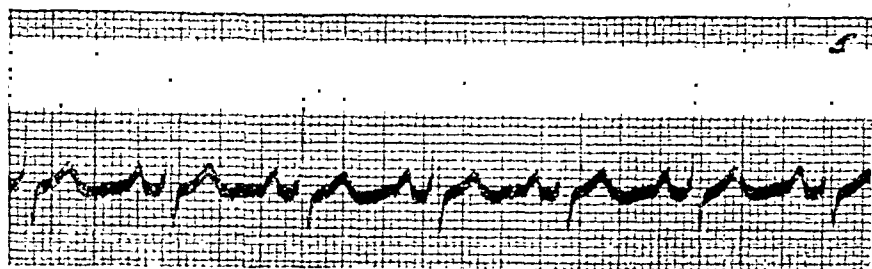


FIG. 5.—February 6, after tincture of digitalis 130 minims. $P-R = 0.16$ second.

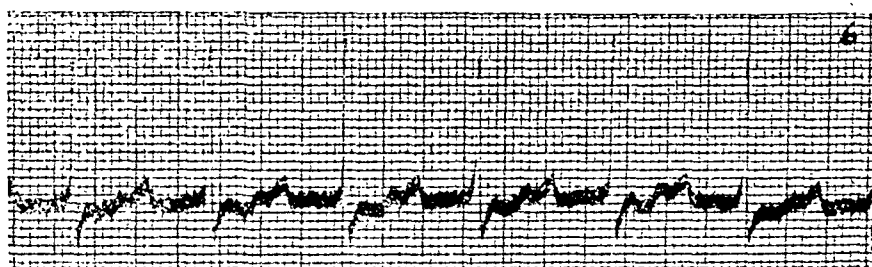


FIG. 6.—February 10, after tincture of digitalis 480 minims. $P-R = 0.36$ second.
Note change in form of T wave. No digitalis after this.

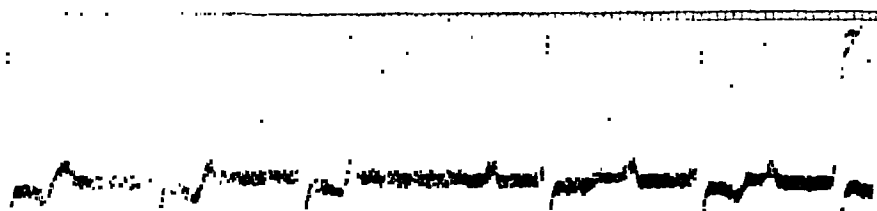


FIG. 7.—February 13. Partial $A-V$ block. $P-R$ (variable) $= 0.48 \pm$ second.
Note change in T wave.

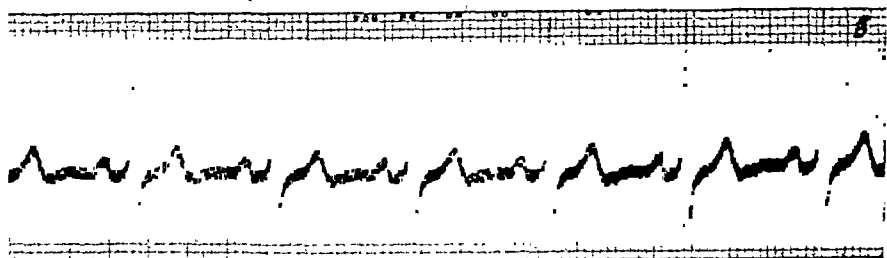


FIG. 8.—March 6. $P-R = 0.18$ second. Curve has practically returned to normal.

FIGS. 5, 6, 7 and 8.—Series of records from a case of bronchopneumonia with recovery, showing the electrocardiographic evidence of thorough digitalization and its long persistent effect.

increase in the heart-rate in the fatal cases was identical whether the subjects were thoroughly digitalized or had received no digitalis during their entire illness. No difference could be noted in the two series in the behavior of the blood-pressure. Daily observations by the auscultatory method were made of systolic and diastolic pressures in many cases. As a rule both systolic and diastolic pressures were low and the pulse-pressure showed a normal range. The level for each of these became established early in the disease and remained remarkably constant throughout the whole course, except that in the fatal cases a terminal rapid lowering of systolic pressure and a diminution in the pulse-pressure appeared to be the rule. Digitalis had no influence on the blood-pressure.

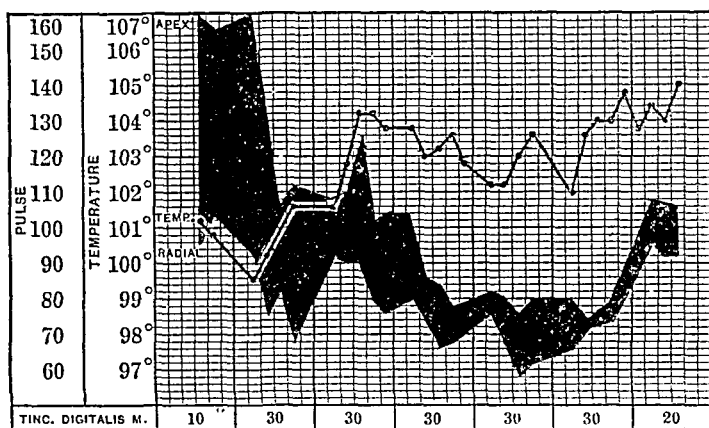


FIG. 9.—Chronic cardiac valvular disease with auricular fibrillation complicated by bronchopneumonia. Terminating fatally. Moderate doses of digitalis control the heart-rate which becomes relatively slow in spite of the high temperature and severe toxemia. The upper edge of the shaded area indicates the heart-rate counted at the apex by auscultation. The lower edge of the shaded area indicates the rate of the radial pulse. The shaded area indicates the pulse deficit.

FIBRILLATION. Among the cases of our series there were two instances of chronic cardiovascular disease with auricular fibrillation. These had certain points in common and presented evidence in regard to the action of digitalis which it is of interest to note. Both these men had been former patients in the Presbyterian Hospital and had been carefully studied. Both had had frank attacks of acute rheumatic fever followed by mitral stenosis and insufficiency and auricular fibrillation. During their former treatment in the hospital each had responded to the administration of digitalis in a satisfactory manner and had been discharged, with reasonably efficient hearts. During the epidemic these patients were readmitted with signs of patches of consolidation and presented typical pictures of the pneumonias seen in other numbers of this group, with the additional signs of cardiac insufficiency. In these cases digitalis was administered at once and continuously. In one the heart-rate, which on admission was 150, fell to 80 after

the administration of 175 minims of the tincture; the other had been taking digitalis before admission, but in spite of this the first observation showed a heart-rate of 160 and a pulse deficit of 64. The exhibition of 100 minims of the tincture of digitalis reduced the heart-rate to 80, with a deficit of 10 (Fig. 9). In each instance the circulatory condition was much improved, the heart became slow and appeared reasonably efficient. However, the temperature continued high, the overwhelming toxemia dominated the picture and the fatal termination came for one on the sixth and for the other on the tenth day of his pneumonia. In neither case was heart failure the apparent cause of death.

Cases of this nature illustrate the fact that in certain cases of auricular fibrillation digitalis acts promptly and efficiently in reducing the ventricular rate even in the presence of extensive consolidation and extreme intoxication.

BLOCK. Our studies lead us to believe that digitalis had the same effect on the hearts of this series as in a similar group without pneumonia. In four instances out of several hundred in which digitalis was given there were found clinical and electrocardiographic evidences of partial heart-block which can only be attributed to the digitalis. One patient on admission presented a coupled rhythm and partial block. On inquiry we elicited the information that he had received six doses of strophanthin and digipuratum every six hours for some days. These drugs had been given subcutaneously, but the exact amounts could not be ascertained. Another who on his first examination showed an arrhythmia which was proved on electrocardiographic examination to be a partial block had been taking considerable doses of the tincture.

A nurse in the training school, aged twenty-six years, admitted on the first day of pneumonia with a perfectly normal heart, showed an arrhythmia due to a partial heart-block on the fourth day of her disease after the administration of 230 minims of the tincture of digitalis. She had a mild pneumonia with an uneventful course defervescing on her sixth day. Electrocardiographic records taken on the first day the arrhythmia was discovered and six days after the administration had been stopped are shown in Figs. 10 and 11. The two records show the characteristic effects of digitalis. The *P-R* interval is prolonged and of variable duration; occasionally there is a blocking of the impulse from the auricle. The *T* wave is characteristically altered.

Another case of our series was a man, aged twenty-five years, who had a very severe but uncomplicated pneumonia of the type usually seen in this series. Although his heart never appeared to be embarrassed, he was given from the first large doses of the tincture of digitalis. When this had totalled 465 minims a partial heart-block appeared. In Figs. 5, 6, 7 and 8 are presented a series of his electrocardiographic records, selected from those taken

at very frequent intervals, which show the characteristic changes of cardiac digitalization and the return of the heart activity to the normal. All four of these patients, showing block following digitalis, recovered and gave no evidence of subsequent ill effects from its administration. We were never able to discover any evidence that the heart of any one of these patients was abnormal. In this connection, however, it is interesting to note the response of different apparently normal hearts to the administration of digitalis.

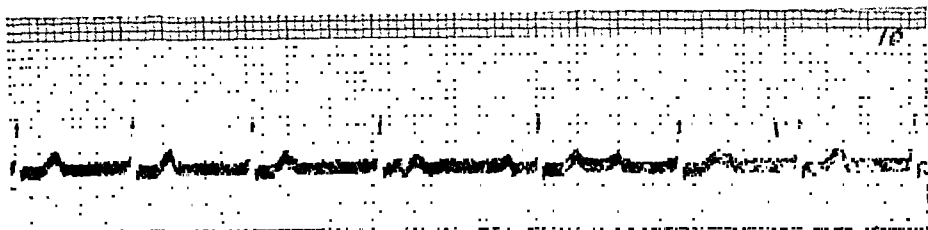


FIG. 10.—January 7, after tincture of digitalis 230 minims. Partial A-V block. $P-R$ (variable) = $0.2 \pm$ second. No digitalis after this.

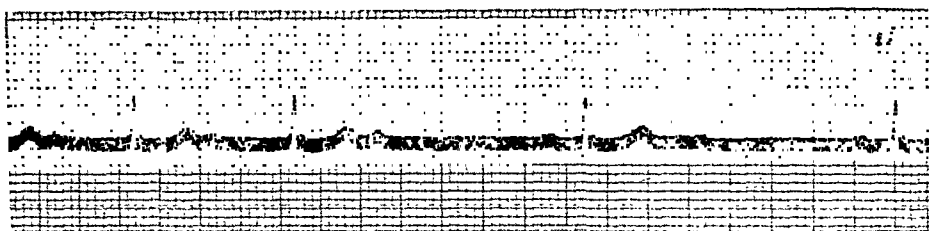


FIG. 11.—January 13. Partial block persists. $P-R$ (variable) = 0.20 to 0.40 second.

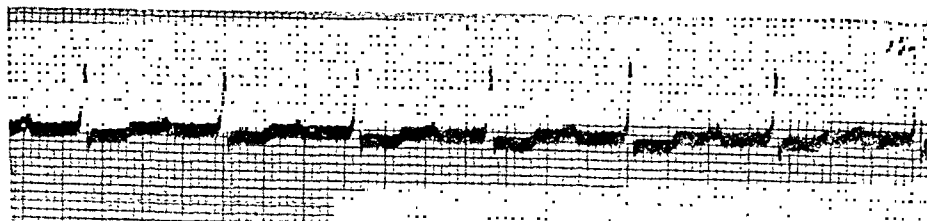


FIG. 12.—January 23. No digitalis since January 7. A-V block has disappeared. $P-R$ = 0.28 second. T wave has changed.

FIGS. 10, 11 and 12.—Case of bronchopneumonia with recovery, showing partial block gradually disappearing after digitalis was discontinued.

In one case block appeared only after the administration of 465 minims of the tincture, in another an almost identical cardiac activity appeared after the administration of 230 minims of the tincture. The first was a man who weighed twenty pounds more than the second patient, who was a woman. There were other patients in our series who received considerably larger amounts of digitalis than the ones now under consideration, and yet showed no evidences of heart-block. With these variations in mind it seems to me it is wiser, unless the need is very urgent, to give

digitalis in moderate amounts and to approach complete digitalization gradually rather than by the use of the enormous initial doses that have been advised by some enthusiastic clinicians. Here, as in other fields of medicine, it is important to individualize, and it is unwise to administer digitalis by arbitrary fixed rules calculated on weight alone.

CHRONIC VALVULAR HEART DISEASE. In our hospital series there were thirteen who on admission presented the evidences of chronic cardiac valvular disease; all showed defects of the mitral valves; 11 were cases of mitral stenosis, with or without mitral insufficiency; 2 showed mitral insufficiency only. As might be expected all the members of this group showed a greatly accelerated heart-rate. With the exception of one man, who died eighteen hours after admission, all of these patients were effectively digitalized. None of them gave any evidence of a beneficial effect of the drug except the two cases with auricular fibrillation, which have already been described; these showed a marked slowing in rate, diminution in the pulse deficit, improvement in the quality of the heart sounds and a distinct betterment in the volume and quality of the pulse; in none of the others could any of these results be secured. Of the cases of mitral stenosis 2 recovered and 9 died. Of the cases of mitral insufficiency 1 recovered and 1 died.

SUMMARY. The evidence here presented indicates:

1. That individuals with chronic cardiac valvular disease withstood the toxemia of the pneumonias of this epidemic very badly.
2. That individuals with normal hearts, who developed pneumonia, did not ordinarily die from cardiac insufficiency, and the postmortem examinations offer no proof that these hearts were essentially damaged.
3. That digitalis acts on the cardiac apparatus of these pneumonias in the same manner as in a similar series of hearts without complicating pneumonias.
4. That digitalis reduced the heart-rate only in cases of auricular fibrillation and in cases where it was administered in quantities sufficient to produce an actual auriculoventricular block.
5. That the administration of digitalis did not influence blood-pressure.

In view of the apparently widespread belief that death in pneumonia is usually due to heart failure and the almost universal dependence that is placed on digitalis in this condition, it behooves us to examine critically the fragments of evidence which we have been able to accumulate in the recent epidemic.

The employment of a method directed against a wrong conception of the pathology may lead to a false sense of security and keep us from directing our efforts to secure remedies better fitted to combat the true pathological condition.

TRANSFUSION OF BLOOD IN PERNICIOUS ANEMIA: REPORT OF AN INTERESTING CASE.*

BY J. M. ANDERS, M.D., LL.D.

PHILADELPHIA.

THIS paper is not an attempt to solve the problem of the genesis of pernicious anemia, although some of the views bearing on this phase of the subject are briefly discussed. Neither can it be claimed to offer anything novel by way of treatment. The chief aim has been to validate the claim advanced by certain writers that transfusion offers more for progressive pernicious anemia than any other form of treatment, by a survey of the clinical results obtained principally by surgeons during the decade last past, Werner Schultz¹ having given a complete bibliography up to 1910.

Some of the gaps in our knowledge of this obscure disease promise to be filled from the field of comparative pathology. For example, Seyderhelm² has demonstrated that injected extracts of the larvæ of the fly, *Estrus equi*, which is found in the walls of the horse's stomach, produce symptoms characteristic of the severer types of anemia.

Seyderhelm has also shown that the hemolytic lipoids derived from the fly larvæ do not cause the symptoms of severe anemia, but rather the non-hemolytic fragments of larval substance.

If the foregoing view be correct the theory of defective hemogenesis, which is held by Henry, Rindfleisch, MacKenzie and other hematologists as the primary cause of pernicious anemia, cannot be altogether abandoned, although injury to the hematopoietic organs, so far as scientific evidence is concerned, occupies a less conspicuous place in the etiology of this disease than toxic hemolysis. It would appear to be clear that the blood picture presented by pernicious anemia reflects an effort of the blood-generating organs to compensate the unusual hemolytic activity of unknown origin. In this connection the abnormally large pigment depositions to be found, more particularly in the liver and spleen, at necropsy in this disease, confirm the highly fatal blood destruction which characterizes the complaint. The fact that defective lipid metabolism results in diminished hemolytic properties of the whole blood should be also recollected.

Additional evidence of the pernicious activity of hemolytic agents in Addisonian anemia is afforded by the presence of an undue quantity of urobilin in the stools. Moreover, Sellards and Minot³ have

* Read before the Association of American Physicians, Atlantic City, June 16, 1919.

¹ In Crawitz, *Klinische Pathologie des Blutes*, Leipsic, 1911, p. 381.

² *Arch. f. exper. Path. u. Pharmacol.*, 1918, lii, 253.

³ *Jour. Med. Research*, 1916, xxxiv, 469.

shown that hemoglobinuria follows the subcutaneous injection of hemoglobin in amounts incapable of producing the appearance of urinary blood pigment in other types of anemia. Eppinger⁴ contends that the excessive erythrocytic destruction, which takes place in the spleen (the exact site of the hemolysis being the splenic pulp) is due to the anatomical changes presented by this organ in pernicious anemia. In those anemias of the pernicious type, which are due to known causes, *e. g.*, malignant tumors, "hemolytic toxins are possibly responsible for the blood condition" (Kullmann⁵), Krehl⁶ and others direct attention to an increased regeneration of erythrocytes in pernicious anemia, which accounts for the escape of immature red cells, including the characteristic megaloblasts, into the circulation.

Sajous⁷ states that hemolysis occurs whenever toxics, either endogenous or exogenous, appear in the blood in quantities sufficient to excite a defensive reaction. He continues: "The antibodies then attack not only the toxics but the erythrocytes as well." H. A. Christian⁸ concludes that in severe cases of Addisonian anemia the renal function is disturbed much as in advanced chronic nephritis. This seems to be either a toxic or nutritional disturbance in renal cellular activity.

On the basis of modern researches and sound data, prophylactic measures are attracting professional attention, after ascertaining the presumable etiological factor in the given case. For example, certain observers attach prime importance to oral sepsis as the cause of the disease; this, however, produces a secondary type of anemia.

L. F. Barker and G. P. Sprunt⁹ have emphasized this phase of the problem, recommending the removal of all discoverable foci of infection; they further advise an abundant, roborant diet, arsenic, the exhibition of hydrochloric acid immediately after meals and of pancreatin and calcium carbonate three hours after each meal. I have mentioned the main details because of their claim that under this treatment splenectomy and transfusion of blood were not found necessary in a special group of cases.

Leyton¹⁰ affirms that massive transfusions of blood offer the greatest chance of improvement to sufferers from pernicious anemia, but, he adds, "Any error in the technic may be followed by a fatal result." Archibald¹¹ transfused a series of 20 cases at the Mayo Clinic, with marked immediate benefit in 69 per cent., while among 14 cases deemed unsuitable for splenectomy similar improvement was noted in 50 per cent. Vogel and McCurdy¹² regard the transfusion of physiologically unaltered blood as a palliative treatment

⁴ Berl. klin. Wehnschr., 1913, c, 2409.

⁵ The Principles of Clinical Pathology, p. 148, Philadelphia.

⁶ Ztschr. f. klin. Med., p. 3.

⁷ Index Supplement, p. 133.

⁸ Arch. Int. Med., October, 1916.

⁹ New York Med. Jour., June 9, 1917.

¹⁰ Practitioner, London, March, 1917.

¹¹ Arch. Int. Med., 1913, xii, 707.

¹² Arch. Int. Med., 1913, xii, 707.

of great promise. Kimpton,¹³ who transfused upward of fifty cases, is of the opinion that transfusion offers more for this disease than any other form of treatment.

It is highly probable, at least, that transfusion of blood in this disease owes its beneficial effects principally to stimulation of the anti-hemolytic properties of whole blood, although possibly also to some extent to its power to increase the activity of the bone-marrow. Obviously, anything that will tend to evoke a strong defensive reaction against the special hemolytic factors will prove useful.

Turk,¹⁴ however, believes that the added blood, combined with some putative hemolytic present, thus protecting the bone-marrow, allows it opportunity to retrieve some of the lost cells.

CASE REPORT.—A. F., aged sixty five years, retired merchant, of healthy parentage began to decline in health about March 1, 1918, growing weak and pale as well as dyspneic. Anorexia soon was complete, and there were belching, abdominal distress, a tired, languid feeling, loss of physical strength and marked mental hebetude.

On physical examination nose, throat, eyes, ears normal; had several decayed teeth which were extracted. There was a marked mitral murmur. May 1, 1918, went to Atlantic City for three weeks, but became progressively weaker during his stay there, so that he had to be removed to his home, not being able to move about without assistance.

May 19, blood count showed: Hemoglobin, 20 per cent. (von Fleishel); erythrocytes, 720,000; leukocytes, 3400. Differential count: polymorphonuclear neutrophiles, 72 per cent.; small lymphocytes, 23 per cent.; large lymphocytes, 2 per cent.; transitional, 2 per cent.; mast-cells, 1 per cent.

Marked anisocytosis and poikilocytosis; megalocytes predominate; polychromatophilic degeneration; very few erythroblasts.

Upon this laboratory evidence and the clinical symptoms and course pernicious anemia was diagnosed. I was called to see the patient May 22 by the attending physician, Dr. S. Shaham, concurred in the diagnosis and gave an unfavorable prognosis, based upon the patient's feeble condition. Transfusion was performed May 24 by Dr. A. J. Rubenstone, 500 c.c. of whole blood from the patient's son, which was found compatible by the Roux-Turner method, being transferred. This was followed later in the day by slight chill, rise of temperature to 102° F., and marked restlessness, from which the patient quickly recovered after injecting several doses of adrenalin chloride and atropin. Rapid clinical improvement followed; color improved markedly, patient asked for food, and within one week he was out of bed.

¹³ Boston Med. and Surg. Jour., May 14, 1918, No. 11, clxxviii, 351.

¹⁴ Vorlesungen über klin. Hamatologie, Vienna, 1912.

Author.	Reference.	Number of cases.	Number of transfusions.	Method.	Results.	Remarks.
L. H. Hemplemann .	Int. Med. Jour., 1910, xvii, 316	1	1	Direct transfusion	"Improvement lasting a short time."	
A. M. Fauntleroy .	U. S. Naval Med. Bull., 1911, v, 47	2	4	Vein to vein	Temporary remissions.	
O. Hanssen . . .	Verhandl. d. Cong. f. inn. Med., 1911, xxviii, 141	14	45	Intravenous injection of defibrinated blood	Remissions in 8 cases; doubtful benefit in 2 and none in 4	First transfusion at times negative; later on effective.
E. Elliot, Jr. . .	Ann. Surg., 1911, liii, 131	1	1	Artery to vein	Remission over 2 months.	
G. Woolsey . . .	Ann. Surg., 1911, liii, 131	2	2	Artery to vein	Decided remission in 1 case; other sl. improved	First case infected with malaria.
J. A. Hartwell . .	Med. Rec., 1911, lxxvii, 1005	1	4	.....	Remissions lasting a few weeks.	
D. Bovaird, Jr. . .	Med. Rec., 1911, lxxix, 239	3	3	Direct transfusion	Remissions in 2	Malarial infection resulted in 1 case. All in terminal stage.
Bennecke	München. med. Wehnschr., 1912, lxx, 1571	4	4	Vein to vein	Negative	
B. M. Bernheim . .	Jour. Am. Med. Assn., 1913, lxi, 268	2	5	.....	1. Repeated remissions; 2. Negative.	
H. M. Vogel and U. F. McCurdy .	Arch. Int. Med., 1913, xii, 707	4	7	.....	Temporary remissions after first injections.	
E. Lindemann . . .	Jour. Am. Med. Assn., Mar. 28, 1914	19	40	.....	11 remissions; 8 unimproved.	
A. H. Noehren . .	Buffalo Med. Jour., 1914-15, lxx, 347	1	1	.....	Died 11 days after transfusion.	
R. Ottenberg and E. Libman . . .	Tr. Assn. Am. Phys., 1915, xxx, 149	25	32	.....	Remissions in 14 cases, 11 not benefited; duration: 1, 3 mos., 3, 6 or more mos.; 3, a year or more; 3, over 2 years.	
J. H. Gibbs . . .	South. Med. Jour., 1915, viii, 48	1	2	.....	Remission.	Reaction in 25 per cent.; 1 patient received 20 transfusions. Developed syphilis from son.
W. V. Brem . . .	Jour. Am. Med. Assn., July 15, 1916, p. 190	24	82	Citrated	.....
J. W. Churchmann .	Jour. Am. Med. Assn., Sept. 9, 1916	1	Several	.....	Marked remission	
E. W. Birtch . . .	California State Jour. Med., June, 1916, p. 240	2	..	.....	1 remission.	

H. E. Milenay, W. W. Stearns, S. G. Fortuine, R. M. Ferry H. Z. Giffin	Am. Jour. Med. Sc., 1917, cliv, 733 Jour. Am. Med. Assn., Feb. 10, 1917, p. 429	40 19	164 ..	Both citrated and whole blood	"Spontaneous remissions definitely hastened in many cases." Marked gain in 8; sl. in 6; no improvement in 4	Transfusions were preparatory to splenectomy. 7 to 10 per cent. gave reactions.
R. D. McClure and G. R. Dunn	Johns Hopkins Hosp. Bull., Mar., 1917, p. 99	17	64	.....	Beneficial, 53 per cent.; no benefit, 35 per cent.; harmful, 10 per cent.	
A. E. Stamford	Lancet, London, March 31, 1917, p. 484	9	..	.....	Marked remissions in 4; less marked in 3.	
R. G. Larabee	Boston Med. and Surg. Jour., April, 1917, p. 553	6	8	.....	Remissions in 4 cases lasting from 2 to 11 months.	
C. R. Minot and R. I. Lee	Boston Med. and Surg. Jour., 1917, clxxvii, 761	46	89	.....	Marked remissions in 9; definite but slow in 20; 17 unimproved	Reactions followed 34 transfusions.
C. G. Heyd	New York Med. Jour., 1917, cvi, 57	1	1	.....	No remission.	
V. P. W. Sydenstricker, V. R. Mason, and T. M. Rivers	Jour. Am. Med. Assn., June 9, 1917, p. 1677	11	49	Citrated.		
O. Leyton	British Med. Jour., April 1, 1916, p. 484	1	2	.....	Remission after first transfusion.	
A. Archibald	St. Paul Med. Jour., 1917, xix, 43	26	46	.....	61 per cent. received distinct benefit.	
C. K. P. Henery	Canadian Med. Assn. Jour., 1917, vii, 18	2	..	.....	1 slightly improved; 1 negative	
E. L. Goar	Texas State Jour. Med., Mar., 1918, p. 388	1	1	Whole blood	Temporary remission.	
V. C. Hunt	Texas State Jour. Med., Sept., 1918, p. 192	123	403	Citrated	Marked remissions in about 60 per cent. with reactions; poor response in 40 per cent. in absence of reactions	Reactions in 94, or 23 per cent.; poor response when no reaction.
E. Sehler	Jour. Missouri State Med. Assn., 1918, xv, 192	1	3	Citrated	Improvement.	
A. Bloomfield	Johns Hopkins Hosp. Bull., 1918, xxix, 101	26	..	Mostly citrated	Remissions in 51 per cent.; average duration 3½ mos.	
S. W. Sappington	Hahnemann Monthly, Philadelphia, 1918, liii, 518	13	19	Citrated	Majority developed remissions lasting several mos. up to 16 mos.	
S. Shahan and J. M. Anders	Not published	1	2	Whole blood	2 remissions.	Last remission still holding.
		450	1084			

June 3, 1918. The patient had resumed his normal activities and a blood count now showed: Hemoglobin, 40 per cent; erythrocytes, 2,050,000; leukocytes, 5400. Differential count: polymorphonuclear neutrophiles, 57 per cent.; small lymphocytes, 34 per cent.; large lymphocytes, 4 per cent.; transitional, 1 per cent.; mast-cells, 1 per cent. Some anisocytosis; megalocytes predominate; some poikilocytosis.

The cardiac murmur had entirely disappeared and improvement from then on was steady. Arsenic and iron injections hypodermically, which he had received since transfusion every other day, were now suspended. The patient was next seen November 19, 1918, and appeared perfectly well. Indeed, he stated that he had "not felt so good for fifteen years."

November 19. Blood count: Hemoglobin, 70 per cent.; erythrocytes, 3,280,000; leukocytes, 5000. Differential count: polymorphonuclear neutrophiles, 63 per cent.; small lymphocytes, 37 per cent.; some anisocytosis and megalocytosis. The patient continued to do unusually well until January 1, 1919, when he slowly developed a relapse. A little pallor, a little cardiac palpitation, dyspnea and anorexia, appeared.

The blood count January 23 showed: hemoglobin, 60 per cent.; erythrocytes, 1,700,000; leukocytes 3600. Differential count: polymorphonuclear neutrophiles, 72 per cent.; small lymphocytes, 26 per cent.; large lymphocytes, 2 per cent. Megalocytosis, reds stain intensely.

March 8. Transfusion repeated. Almost no reaction followed, but improvement was immediate, although somewhat slow and gradual. He has now, May 15, 1919, returned to the same state that he presented in November, 1918. Blood count: hemoglobin, 65 per cent.; erythrocytes, 3,160,000; leukocytes, 6000. Differential count: polymorphonuclear neutrophiles, 62 per cent.; small lymphocytes, 33 per cent.; large lymphocytes, 3 per cent.; transitional, 2 per cent. Patient's general condition is now remarkably good, just one year after the first transfusion, being able to attend to duties that he has not performed for the past ten years.

It was the surprisingly brilliant result obtained in this case, that impressed me with the need for a careful survey of the recorded experiences of clinicians and surgeons with this procedure during the decade last past. The accompanying table sets forth the main results of my collective investigations.

The totality of 450 cases, in which 1084 transfusions were performed, is large enough to base thereon a fairly accurate estimate of the value of transfusion as a remedial measure. Considerable light has been thrown upon the question of the duration of remissions by transfusion by these observations, although the reports are too often silent on this phase of the effects of the procedure. Of 362 cases in which the result was given, 204, or 56.3 per cent., showed

an initiation of remissions. Cases in which the improvement was brief and might have been ascribable to the mechanical effects of the transfusion were not included in the figures representing remissions. It is worthy of note that the average number of transfusions per patient was 2.4, while the extremes ranged from 1 to 20 operations.

Weber,¹⁵ Hurter¹⁶ and others have, as a result of personal observation, reached the conclusion that repeated smaller transfusions, *e. g.*, "200 to 500 c.c.," which are free from dangerous reactions, give more satisfactory results than single, massive ones. The series of cases which make up the accompanying table confirm this view. Single transfusions, however, prove sufficient in a certain percentage of cases (11 out of 26, Archibald). The determination of the precise amount of blood to be transferred is a question requiring further study and investigation. Of 185 cases in which the method was mentioned, 172 were transfused with citrated blood.

In this connection Vogel and McCurdy conclude, as the result of their studies that "The enumeration of the reticulated cells by means of the method of vital staining affords a useful means of gauging the hemopoietic activity of the bone-marrow, and by watching the patient's progress in this way the indications for and effects of various therapeutic measures can be well determined and supervised." The intervals in the case of multiple transfusions, must be determined by repeated examinations of the patient's blood, preferably by the method of Vogel and McCurdy, since this is the only trustworthy method of estimating their effect. Obviously, the patient's general condition and subjective sensations must likewise be taken into account.

The splendid results achieved from transfusions by a large number of excellent observers, in an innately fatal disease in which the diagnosis cannot be said to be conjectural, except at an early stage, render it highly expedient to determine their precise field of usefulness. Shall they be employed so soon as the diagnosis of the disease can be made with accuracy in progressive cases? or shall they be limited to the cases that have proved refractory to the arsenical treatment including salvarsan and neosalvarsan, "with results that promise their continued use as the most certain form of therapy in this disease?"¹⁷

It is believed by a number of competent observers, *e. g.*, Bovaird,¹⁸ Lee, Minot and Vincent,¹⁹ Ottenberg and Libman,²⁰ and others that when the hemoglobin percentage falls to or below 20 per cent. transfusion of blood offers the possibility not only of averting death;

¹⁵ Deutsch. Arch. f. klin. Med., 1909, xcvii, 165.

¹⁶ Med. Klin., 1911, No. 12.

¹⁷ Da Costa's Handbook of Medical Treatment, ii, 21.

¹⁸ Medical Record, February 11, 1919.

¹⁹ Jour. Am. Med. Assn., September 2, 1916, p. 719.

²⁰ AM. JOUR. MED. SC., July, 1915, p. 36.

but at times at least of initiating one of the periods of quiescence so characteristic of the disease.

That it is unwise to wait until the average hemoglobin percentage falls as low as 20 per cent. is a conclusion supported by both clinical experience and statistical evidence. Ottenberg and Libman²¹ found that the average hemoglobin percentage before transfusion of 14 cases which showed remissions was 27 per cent., "whereas the average of 9 cases which show no remissions (excluding rapidly fatal cases) was only 20 per cent.

In the case which had reached an advanced stage before the procedure was resorted to, briefly reported above, the effects of the first transfusion were decided and lasted about eight months, and a second transfusion gives promise of an equally favorable result. As a means of establishing a reputation for the procedure, however, the limitation of its use to well-nigh hopeless cases is not promising. The present researches indicate clearly that earlier transfusions in cases showing no tendency to spontaneous remission or as the result of the more usual methods of treatment would yield the best results. Again, remissions are more easily induced in the earlier than the later stages of the disease.

Transfusion does not prolong the period of remission. Cabot's figures show the quiescent period to be over 6 months in 165 out of 329 cases, whereas in my series, so far as could be ascertained from available literature, it was somewhat shorter on the whole. On the other hand, this measure easily brings about an increased number of remissions, hence it is not unreasonable to suppose that the total duration of life may be thereby prolonged, as was doubtless the case in many instances included in my table. Evidence exists to show that those examples of the disease which have shown most improvement after transfusion had run a prolonged course as a rule, while the more rapidly progressive cases manifested a feebler remission.

Two methods of administration of defibrinated blood—namely, by intramuscular and intravenous injection—have been advocated, but the results are less satisfactory than those yielded by whole blood. Curtis and David,²² after making experiments on dogs, consider defibrinated blood unsuitable for human transfusion and Pike, Guthrie and Stewart,²³ and others have found that defibrinated blood on standing a few hours undergoes changes affecting the corpuscles and impairing its nutritive and bactericidal qualities. In view of these facts, and remembering that fresh unaltered blood can, thanks to the recent advances in vascular surgery, be safely transferred from one individual to another, the further use of defibrinated blood is rendered quite undesirable.

It has been suggested to employ antidiphtheria serum in those examples of the disease in which the toxemia predominates and

²¹ Loc. cit.

²² Surg., Gynec and Obst., 1912, xv, 476.

²³ Jour. Exper. Med., 1908, p. 371.

counteracts the action of the arsenic. It seems to me, however, that in many of these cases more favorable results would be obtained from the injection of whole blood after combating discoverable causes. The same remark applies to venesection which has been advised as a palliative measure. Other special methods of treatment have been employed in cases refractory to arsenic and iron therapy, *e. g.*, by the hypodermic use of splenic extract (Maikhailoff) and antistreptococcus and antistaphylococcus serums; but these have not gained an enviable reputation for themselves, and it is unwarrantable to permit them to supersede transfusion of blood, which deserves a more extended trial and promises a far better therapeutic effect.

From an examination of the available literature and personal observation and knowledge of individual cases, I concur in the opinion expressed by Kimpton that the results of splenectomy hardly warrant the operation. This view is based on the assumed facts that transfusion offers quite as much as splenectomy, "with or without transfusion" (Kimpton), and that it obviates immediate deaths. The belief among certain observers that transfusion following splenectomy brings a more steady response than without splenectomy is not borne out by professional experience as a whole.

Krumbhaar,²⁴ in a series of the late results of splenectomy in 153 cases, noted a mortality rate of about 20 per cent., and also that, as a rule, the improvement was transient. Moffitt,²⁵ in an earlier article, states that of 33 cases of splenectomy for pernicious anemia gleaned from the literature, including one under his own observation, "eight died immediately or not long after the operation."

It is obvious that a method of "so great promise as transfusion should be more widely adopted as a means of prolonging life. Berheim²⁶ has reported the interesting case of a man admitted to the clinic of Dr. J. C. Bloodgood, who was transfused four different times from three donors and lived two years after having been given up as lost. In the small percentage of cases in which severe and increasing reactions follow the use of homologous blood, the injections should be discontinued.

Since the technical success of the operation in competent hands is assured, both as regards the recipient and donor, it should be repeated with sufficient frequency to avoid the development of an extreme degree of anemia.

The question arises, Have we not arrived at the point at which internists and general practitioners, under whose observation and care pernicious anemia first falls, as a rule, should advise immediate transfusion after an assured diagnosis has been made, during the non-quiescent period, seeing that it initiates a prompt remission in at least 56 per cent. of the cases? This procedure should be,

²⁴ Jour. Am. Med. Assn., 1916, lxxvii, 723.

²⁵ AM. JOUR. MED. SC., No. 6. cxlviii, 822.

²⁶ Jour. Am. Med. Assn., 1913, lxi, 268.

however, supplemented by appropriate hygienic measures and approved medicaments, and in cases which are refractory to transfusion the usual medical treatment by arsenic, including salvarsan intravenously, and subcutaneous injections of iron, should receive a trial before resorting to other methods of treatment. Finally, the dictum that this measure, when skilfully employed, offers more than any other method of treatment alone, is confirmed by the results of my collective studies.

My sincere thanks are due Dr. S. Shaham, for permission to publish the report of his interesting case, and also Dr. A. J. Rubenstone, for certain details connected with his two transfusions.

HYPERTENSION: ITS SIGNIFICANCE, RELATION TO ARTERIO-SCLEROSIS AND NEPHRITIS AND ETIOLOGY.¹

BY ELI MOSCHCOWITZ, A.B., M.D.,

PATHOLOGIST TO BETH ISRAEL HOSPITAL, NEW YORK CITY.

(From the Pathological Laboratory, Beth Israel Hospital, New York.)

SIGNIFICANCE OF HYPERTENSION. The introduction of the sphygmomanometer has been of profound consequence to clinical medicine. It has helped to clarify our knowledge of many diseases associated with alterations of circulatory dynamics; it has introduced new concepts into clinical medicine, refined prognosis, made clearer our understanding of the action and benefit of certain drugs and has made our therapy of circulatory disturbances more subtle. At the same time there is no instrument of precision whose correct use is more commonly misapplied. This is especially true in relation to that group of disorders associated with "hypertension."

At the outset it must be emphasized that hypertension is not a disease but a symptom. The conception of a hypertension as a disease dates from the earlier years when the sphygmomanometer revealed an increase in blood-pressure in instances in which it was not distinguishable by the *tactus eruditus*. Viewing hypertension as a disease efforts were directed to reduce the blood-pressure at all hazards, so that the use of vasodilating drugs, especially those of the nitrite group, became a common custom. The view is now held that hypertension, instead of being an unmitigated evil, represents a compensatory process, brought about by the attempts of the circulatory apparatus to regulate the proper distribution of the blood volume. Certain it is that a high arterial tension is perfectly compatible with well-being, and is often discovered by pure accident. On the other hand it is a common occurrence to witness that both

¹ Read before the Clinical Conference, Mt. Sinai Hospital, New York City.

the subjective and objective phenomena of a condition associated with hypertension improve under treatment, although the blood-pressure, especially the systolic, has not been altered appreciably. Viewed in the light of a compensatory process, an increased arterial tension bears an entirely different significance. In the strictest sense of the word, therefore, a circulation in which a high arterial tension is an element is in a state of decompensation; that is, its maximum efficiency is to a certain extent impaired. There is much confusion in the minds of most authorities as to what we understand by the term "decompensation" in cardiac disorders, probably for the reason that we do not understand the exact forces that bring decompensation about. In our minds "decompensation" connotes the graver signs and symptoms of cardiac disease, such as breathlessness, aggravated forms of cardiac rate and rhythm, anasarca, etc. But, strictly speaking, any deviation from the normal represents a state of circulatory decompensation, and these deviations may refer to both subjective and objective phenomena.

Subjectively the patient's complaints may vary from a slight fatigue or breathlessness or occasional mild headache to the severe inertia, panting and splitting vertex headaches of the advanced nephritic. Objectively the patient may reveal a gamut of signs varying from simple hypertension to the profound circulatory disturbances of advanced cardiac disease. Moreover my observations lead me to conclude that the subjective and objective phenomena of decompensation represent a progressive process, and that every persistent hypertension, unless complicating factors are introduced, will eventually result in the graver evidences of decompensation represented under the conventional clinical picture of cardiac insufficiency. This suggests the following theorem: *Every patient in whom a persistent hypertension is found requires not only observation but treatment; and the form of treatment depends upon how far we are able to restore the patient's condition, both subjectively and objectively, to the normal.* I emphasize both terms, subjectively and objectively, because I have seen not infrequently patients in whom the subjective symptoms were almost completely relieved, although the objective findings were not appreciably altered. It will be found in the vast majority of instances that treatment will restore compensation up to a certain point beyond which we cannot pass. It has often been asserted that a circulation associated with a hypertension even of a considerable degree can never be restored to the normal. But I am convinced that this statement is not correct. I know of a number of instances in which hypertension, associated with the usual subjective and objective phenomena, such as breathlessness, fatigue, headache, oliguria, albuminuria, etc., has disappeared completely and thus far remained absent.

VARIETIES OF HYPERTENSION. Much has been written of late of "essential" hypertension or "hyperpiesis," By these terms we

refer to cases in which hypertension is manifest with a left ventricular hypertrophy, but without any appreciable clinical evidences of kidney or arterial disease. Indeed, such cases have come to autopsy and no disease of the arteries or the kidneys has been found. Recognizing, however, that hypertension is known to occur with outspoken clinical and pathological evidences of arteriosclerosis and kidney disease, clinicians have attempted to classify hypertension from the standpoint of etiology, therefore, into three distinct types: (1) Arteriosclerotic; (2) nephritic; (3) essential. The fallacy of this classification is that it attempts to explain etiology in terms of pathological anatomy. Because a certain pathological lesion is found at postmortem is no proof whatever that this lesion was the cause of the signs or symptoms during life. A lesion may very well be the end of a physicochemical or metabolistic process which is not demonstrable at the autopsy table. It would be equally logical, for instance, to conclude that the left ventricular hypertrophy or an apoplexy is the cause of the hypertension, although we know that these lesions are the result and not the cause. Furthermore, such a classification does not take into consideration the fact that the status of the patient either clinically or at the postmortem table represents simply a phase of the disease and not a complete end-result. We are all familiar with cases of so-called essential hypertension which after several years have developed all the graver manifestations of kidney or arterial trouble. Indeed, I question whether every case of essential hypertension, unless cut down by some intercurrent malady, will not eventually develop signs of advanced kidney or arterial disease. All the evidence seems to show, as I shall shortly elucidate, that the majority of the so-called arterial and kidney diseases which have hitherto been regarded as the causes of hypertension are rather the result of hypertension rather than the the cause, and that therefore the terms "essential" hypertension, "arteriosclerotic" hypertension and "nephritic" hypertension are phases of one and the same process rather than three sharply defined clinical entities. A concept based upon this thesis will, I believe, help to eliminate much of the confusion in current writings of the subject. I therefore shall try to show that many, perhaps the vast majority, of so-called types or varieties of hypertension begin as simple "essential" hypertensions, and that eventually, after a sufficient lapse of time, such "essential" hypertensions assume the clinical form of "arteriosclerotic," "nephritic" and other hypertensions.

This classification, I repeat, is not etiological but clinical and teleological, and is of value only as emphasizing the organ or organs more prominently affected in the course of the disease and the immediate cause of death.

Such a classification, moreover, is incomplete, because it emphasizes only two of the organs that are affected in hypertension,

namely, the arteries and the kidneys. Now, hypertension is a malady that affects the circulation and therefore the function of all of the internal organs, and because of their critical function, the heart, the brain, the aorta, the arteries and the kidneys stand out prominently. Clinical manifestations involving one or more of these organs reveal themselves in every case of hypertension at one phase or other of the malady, so that a complete classification would include not only the nephritic and arteriosclerotic types, but the cardiac, cerebral and aortitic types as well. Such a classification would bear the additional merit of conforming to the three main kinds of death that come to such patients: (1) Cerebral (apoplexy); (2) cardiac (insufficiency, coronary disease); (3) nephritis (uremia). Why a hypertension should emphasize the lesion in one or the other organ is a problem that is at present not understood. In most instances, indeed, it is difficult to determine which organ is more severely affected.

I am not willing to assert at this time that all hypertensive states begin as cases of essential hypertension. I shall discuss the conditions under which a hypertension may be secondary in a subsequent part of this paper. This question has given rise to two great problems that have been vexing those interested in the subject: (1) The relation of hypertension to arteriosclerosis; (2) the relation of hypertension to nephritis.

1. *The Relation of Hypertension to Arteriosclerosis.* The fact that hypertension occurs, as a rule, at that time of life when sclerotic lesions in the arteries become prominent has led many to believe that the sclerotic changes are the cause of the hypertension. But there is no fact more easily demonstrable in every autopsy room than that profound sclerotic changes may be manifest without the slightest evidence of hypertension during life (senile or decreascent type of Allbutt), and conversely that an extreme hypertension may have been present with little if any changes in the bloodvessels. Indeed, there is no relationship whatever between the extent of the arteriosclerosis and the height of the blood-pressure.

Whatever experimental evidence we possess seems to show that arteriosclerosis, sometimes at least, is the result and not the cause of a continuous state of hypertension. The frequency of arteriosclerotic lesions in animals after repeated injections of such blood-pressure raising substances as adrenalin, nicotin, barium chloride, etc., are well known; more convincing, because a direct toxic effect is eliminated, are the experiments of Harvey and Klotz, who maintained a continuous hypertension in young animals by placing them in an inverted position for three minutes over a period of 120 days, at the end of which time marked sclerotic changes in the bloodvessels were manifest. As further evidence of the direct effect of pressures on the formation of arteriosclerosis, we cite the well-known observations that atheroma is especially common at those areas of the

arterial tubes in which pressures are greatest, such as "at bifurcations; at narrow points whether normal or morbid and at dilatations with change of wave leading to distortion and elongation" (Allbutt). In congenital stenosis at the site of ductus Botalli, for instance, the aorta on the proximal side and the carotids and the cerebral arteries are extremely diseased, while on the distal side the internal surface of the vessels is normal.

2. *Relation of Hypertension to Nephritis.* Here we are treading upon a far more debatable ground. It is admitted that in practically every case of hypertension, albumin, most often a trace, with or without casts, is present in the urine. The questions then to determine are the following: (1) Does the presence of albumin, with or without casts, represent real damage to the kidney in the sense of a nephritis? (2) What clinical criteria do we now possess that a nephritis is present in the anatomical sense? (3) If an anatomical nephritis is proved by autopsy, how can we determine whether it is primary or secondary? (4) Is a proved anatomical nephritis always accompanied by the changes of the urine, conventionally associated with the term "nephritis," namely, albumin and casts? (5) Is there any proportional relation between the amount of damage to the kidney and the urinary and clinical findings, with special reference to the degree of hypertension? (6) Is there any definite relation between either the presence or degree of hypertension to the three conventionally described types of nephritis, namely: (a) Glomerular nephritis; (b) parenchymatous nephritis; (c) interstitial or arteriosclerotic nephritis? In other words, does the presence or degree of hypertension depend upon the extent of damage to the glomeruli, the tubules or to the interstitial tissue with its containing bloodvessels? (7) Have we any demonstrable proof that a hypertension may occur without an anatomical nephritis? (8) What do we understand by the term "nephritis" in the pathological sense?

As the answers to these questions will, in a great measure, overlap each other, I shall discuss these matters rather freely.

In the first place, does the presence of albumin, with or without casts, represent real damage to the kidney in the sense of a nephritis? The answer, of course, is a decided "No." The best proof is the absence of any kidney lesion in cases of orthostatic albuminuria in which even large amounts of albumin, and occasionally even casts, are present, although the kidneys are normal. The greatest difficulty that arises in an attempt to settle this problem is the fact that a kidney absolutely free from some evidence of inflammation is rarely found at autopsy, especially in adults, in whom hypertensive states are most likely to occur. Pathologists permit themselves a very wide latitude in their interpretation of an inflammation of the kidney, and will include everything from a slight cloudy swelling of the tubules or a slight round-celled infiltration to the

grossest destruction of the kidney parenchyma. With such a latitude a perfectly normal kidney is an almost impossible phenomenon in the adult. On the other hand, every pathologist knows that the extent of a degenerative or interstitial process in the kidney is the worst kind of a guide as to the amount of albumin in the urine. It is not uncommon to see a slight degenerative change associated with an enormous quantity of albumin, while an intense and widespread degenerative and interstitial process, the so-called contracted kidney, for instance, is associated with mere traces. On the other hand, it is not at all uncommon to find even an intense chronic nephritis without any history of a persistent albuminuria during life. It is admitted that albumin, as discovered by the conventional clinical methods, connotes a pathological change in the organism. What then is the significance of albumin in the urine? The process of urinary excretion is exceedingly complicated and depends on many factors, many of which are still not closely understood (Cushny). However, in whatever light the function of the kidney may be viewed, albumin may arise in the urine as the result of one or more of the following factors: (1) A change in the colloidal constitution of the plasma permitting a greater diffusibility of albumin through the vessels; (2) degenerative changes in the kidney epithelium, with consequent alterations in filterability; (3) autolysis of kidney parenchyma, with solution of proteins into the urine; (4) bloodvessel changes, especially of the glomeruli, permitting albumin to escape more readily into the tubules; (5) static changes in the blood supply of the kidney, whereby intravascular and extravascular balances of pressure are disturbed.

The precise relation of these factors to the excretion of albumin in the urine has, as far as I am aware, not yet been formulated. I only wish to point out that the prevalent conception of albuminuria as being due wholly to a gross injury of the kidney parenchyma is, in my opinion, greatly exaggerated. I am willing to admit that this factor perhaps plays the largest role in the albuminuria of acute infections, in which changes, especially cloudy swelling, of the kidney epithelium is a prominent lesion; but I do not believe it is a factor of much consequence in the albuminurias associated with hypertensive states.

On the other hand, I believe that the last factor, namely, static circulatory conditions within the kidney itself, with or without vascular lesions, are the dominant causation of most of the albuminurias not associated with the infections. My interest was focussed on this phase of the problem many years ago. It happened as the result of one of those rare opportunities in being able to observe closely over a period of four years a case from its very inception to the autopsy, during which time practically all the clinical and urinary examinations were made by myself, so that my interpretation was not in the slightest degree biased. The case was that

of an aged physician who suffered from attacks of cardiac decompensation (auricular fibrillation), as the result of an aneurysm of the left ventricle, brought on by coronary thrombosis. The patient felt perfectly well previous to his attack of coronary trouble, and his urine had always been normal. The blood-pressure was always normal. He was kept under the constant use of digitalis, to which he responded perfectly, so that in the intervals between his attacks of cardiac insufficiency he felt well. His pulse was slow and regular, and this is the point—*his urine was perfectly normal; there never was the slightest trace of albumin*. When, for any reason or other, failure to use sufficient digitalis, overexertion, etc., severe cardiac insufficiency occurred, as evidenced by a rapid and perpetually irregular pulse, dyspnea, hypostatis, etc., the urine at once contained greater or lesser traces of albumin, with casts. When compensation became restored the urine again became free. The attacks of decompensation became more frequent and became harder to control; finally, the heart lost its reserve and the patient died during an attack which began only about a week before he died. The autopsy revealed a great surprise. At the autopsy both kidneys showed an advanced nephritis of the contracting type. The cortex was only about $\frac{1}{2}$ cm. thick, the markings were completely obscured and there were marked glomerular and interstitial changes.

Here, in other words, was a kidney so badly damaged that if we view the kidney simply as a filter we had reason to expect the most profound changes in the urine. 'On the contrary the urine was entirely normal and free from albumin, except when the circulation was at fault.

Incidentally, this case also proves that a contracted kidney is not always associated with a high arterial blood-pressure, as some would lead us to believe. I shall refer to the relation of contracted kidney to hypertension in a subsequent part of this paper.

The contention that albuminuria is the result or, at least, is modified by circulatory changes is paralleled by other observations. Every clinician knows that in frank valvular disorders of the heart albuminuria rarely occurs except during the stages of severe cardiac insufficiency. Furthermore, if it does occur during "compensation" it is invariably increased during the stage of insufficiency. This observation is especially significant in view of the well-known fact that in the chronically congested kidney the renal epithelium is unusually well preserved.

Furthermore, similar circumstances hold true in hypertension. When the patient, both clinically and objectively, is in the stage of good compensation the albumin remains quantitatively the same. When decompensation occurs the albumin increases. Moreover, and this is significant in both conditions, namely, valvular heart disease and hypertensive states, the improvement in the amount of albumin is directly influenced by treatment of the circulatory

failure alone. My own impression is that in these cases the amount of albumin is roughly proportionable to the diuresis.

The integrity of the kidney as a filter against albumin, therefore, depends in great measure upon fine adjustments of blood supply. Which are the forces in the dynamics of the circulation that disorganize this adjustment we can only surmise. Variations in arterial pressure alone cannot be entirely responsible, because sometimes an increase and sometimes a decrease may increase the quantity of albumin. Regularity or irregularity of heart action obviously plays no role. The only other factors that may be considered are three: blood velocity, volume flow and change in blood viscosity. Blood velocity is the rate with which a given volume of the blood flows passed a certain point. "By volume flow is meant the volume of blood passing through a vessel or organ in a definite time, independent of whether its velocity is great or small." (Wiggers.) Inasmuch as the volume varies with the size and weight of the organ, physiologists have calculated the minute volume flow in terms of 100 gm. of substance. By such a method it is found that the minute volume flow varies widely in different organs, being least in the lower extremity and greatest in the thyroid. Which of these three factors, variation in the blood velocity, the minute volume flow or blood viscosity, or a combination, is responsible for these variations in the albumin and kidney function it is at present impossible to say. My own guess is that all factors are responsible with the minute volume flow being by far the predominant one, for the reason that is more widely influenced by pathological conditions.

It is not generally appreciated, as it should be, that our present clinical methods of determining the function of the circulatory system furnishes us with only a limited and, above all, the least important information. We have excellent means of determining the rate, the rhythm, the pressure, the conduction impulses and the topography of the circulatory organs; but the most important information, namely, the actual work of the heart, we can only guess at. To determine the velocity and the minute volume, very complicated methods, requiring the facilities of a well-equipped physiological laboratory, are required.

Thus far we have only been discussing albuminuria as an evidence of disordered kidney function. We always regard albuminuria as the earliest and most constant symptom, probably because its clinical determination is the easiest. But albuminuria is not the only sign of disordered kidney function; functional tests also comprise the determinations of gravity and quantity, salt balance, the phenol-sulphonaphthalein tests, the quantitative examination of the blood for non-nitrogenous products, urea, creatinin, globulins and lipoids, etc. The correct interpretation of these tests has shown (1) that disordered kidney function is not a simple thing but covers a wide variety of pathological-physiological states. We are now able to

roughly group disordered kidney function into certain types, representing in our minds various clinical concepts. Unfortunately these clinical concepts have proved thus far to have no precise pathological foundation. In other words, we are still unable to predict the type of kidney or the amount of destruction of the different renal components we expect to find at autopsy, except to only a limited degree. The classification thus far is only a biological one. (2) Furthermore, these tests have shown that a disordered kidney function may be present even before albumin has appeared in the urine. It is therefore perfectly possible that had some of the above tests been applied to the patient I have mentioned, in whom an advanced chronic nephritis was found at autopsy, a disordered kidney function may have been discovered even during the periods when albumin was absent in his urine. It is not at all an unreasonable conjecture, therefore, that one of the above tests or one that may yet be discovered may prove to be a forerunner of a disordered kidney function even long before albumin is discovered in the urine; just as we know that the potential diabetic has an increase in blood sugar long before glycosuria appears.

Have we any demonstrable proof that a hypertension may occur without an anatomical nephritis? I have never seen one, but my experience is confessedly limited. However, the cases reported are sufficiently numerous to warrant the assertion that a patient may have hypertension, and may even die as the result of the hypertension, and yet have practically normal kidneys. These cases are comprised under the groups termed "essential" hypertension or "hyperpiesis." But I am as yet by no means convinced that the observations of those who report normal kidneys in hypertension are valid. My reasons for saying this are the following: (1) That in my experience a perfectly normal kidney in the middle-aged adult is almost never found. (2) That the interpretation of what constitutes a "nephritis" varies so widely even among pathologists. A nephritis does not necessarily constitute injury to the epithelium, but to the interstitial tissue and bloodvessels as well, and it is by no means uncommon to see kidneys, with seemingly intact epithelium, but with definite changes in the glomeruli and vessels, with or without slight round-celled infiltration or increase in the interstitial tissue. I would not mention this except that I know of one instance at least in which an experienced and well-known clinician reports a case of "hypertension without nephritis," although his accompanying illustration shows a well-marked round-celled infiltration of the interstitium. (3) I have performed autopsies on patients who had hypertension during life, in whom I found kidneys in every way normal, except that they showed slight or moderate degrees of round-celled infiltration in scattered areas of the cortex; with occasional hyaline change in the glomeruli. Now, as I have already intimated, there is nothing in pathology more apparent than the remarkable

lack of relationship between functional tests of disordered kidney function and the variety of kidney that we find at autopsy. Indeed, it is hazardous to predict the type of kidney, which the pathologist will find at autopsy from clinical findings alone, and that is why a classification of chronic nephritis on the basis of anatomical types has proved a failure. This is not surprising when we consider that even a classification of nephritis on an anatomical basis is attended by almost insurmountable difficulties. Witness, for instance, the bewildering confusion in classifications in current text-books on pathology. We find the "small red kidney," the "large and small white kidney," "parenchymatous nephritis," "glomerulonephritis," "interstitial nephritis," "tubular nephritis," "diffuse nephritis," "granular kidneys," "indurative nephritis," the "arterosclerotic kidney," etc., and we are given to understand that each is a separate type, with a distinct and separate gross and microscopic lesion of its own.

Now upon what does the appearance of the disease of the kidney depend? It depends upon (1) the amount and character of alterations in the structure of the glomeruli; (2) upon the variety of degeneration and its extent in the tubular epithelium; (3) in the amount, character and situation of the replacement connective-tissue fibrosis; (4) upon the extent of the blood supply and the amount of sclerotic change in the bloodvessels; and lastly (5) upon the extent of the compensatory changes in the intact portions of the kidney parenchyma. We may therefore expect all kinds of appearances, depending upon the extent, variety and situation of these changes. *Such changes as I have described are present in practically every subacute or chronic inflammation of the kidney, so that in the strictest sense of the word every subacute or chronic inflammation of the kidney is a diffuse one, involving glomerulus, epithelium, interstitial tissue and bloodvessels en masse.* In some, lesions of the glomeruli are predominant; in others, the degenerations of the epithelium; in others, the growth of new connective tissue; but one is not found without the other. The interstitium may show only a slight scattered cortical round-celled infiltration, but such changes are not present without some lesions of the glomeruli or epithelium. Obviously, therefore, a classification depending upon the predominance of the lesion in a certain component of the kidney structure is entirely arbitrary and is not justified by facts. A glomerular nephritis is therefore a parenchymatous nephritis and an interstitial nephritis as well, and *vice versa*.

Microscopically, there is a striking morphological uniformity of the lesions no matter what "type" the kidney may be. In other words the only differences between the "large white kidney," the "red granular kidney" and the "contracted kidney" are in the extent and degree and maturity of the lesions. Indeed, the similarity microscopically is so striking that one cannot escape the thought that all these various types have one and the same patho-

genesis, and that, according to well-established morphological criteria, they merely represent stages of a single process. These kidneys therefore represent a scale in which, roughly, the first stage is represented by scattered round-celled infiltration of the cortex, with associated slight glomerular changes and degenerations of the epithelium; the next stage is represented in the so-called "white kidney," in which the round-celled infiltration is far more extensive and the changes in the glomeruli and epithelium are more marked and diffuse; a more advanced stage is the "red and granular" kidney, in which much of the round-celled infiltrations has become frank scar tissue; the glomeruli have become fibrous and hyaline while some of the intact tubules show compensatory changes in the form of small gray granulation-like elevations, which appear prominently above the cortex, and the capillaries are congested. Finally, we find the small, contracted kidney, in which the lesions of the various components are so marked and the amount of connective tissue is so dense that the structure has been completely disorganized. This is the only type of chronic nephritis that may be considered an end-product, for it is hardly conceivable how such an intense degeneration could proceed further, and it is equally not conceivable how such a deformed and scarred kidney could have resulted without having passed through such changes as I have described. The distinctions therefore that have been made between "primary" and "secondary" contracted kidney I hold, therefore, to be entirely unwarranted. These gradations are entirely analogous to the method of production of any interstitial change in any organ of the body, as in the liver, the uterus and ovary for instance, or that witnessed in the conversion of granulation tissue into scar tissue.

Therefore, with the exception of the contracted kidney, each of these types of kidney lesion, which I repeat is only exceptionally pure and nearly always mixed, represents a phase of a single progressive pathological process rather than a definite end-product. The type of kidney we shall find depends entirely upon the period in which the decompensation is no longer responsive to treatment. Each has potentialities, provided the patient lives long enough, to pass into a more progressive stage. Such a lesion, therefore, should not be regarded as the sole cause of death, but only as a greater or lesser contributing factor and as an incident in the pathogenesis of a chronic inflammation of the kidney. The primary cause of death may be conceived as a functional rather than an anatomical one.

I am not prepared to say that all chronic nephritides pass through all the stages that I have described. The effect of a toxin may be so profound, *e. g.*, scarlet fever, that even the earliest kidney change may be represented by a morphologically advanced glomerulonephritis, but in the vast majority of lesions associated with hypertension states the lesion, I believe, progresses in the manner I have described.

I believe, therefore, that the lesions represented under the term "Bright's disease" are not primary in the vast majority of instances and are not the direct cause of hypertension but represent the response to a continuous circulatory vasoconstricting influence or to the substance that brings about this influence.

My reasons for believing that certain forms of chronic nephritis are secondary to a persistent hypertension or of the causes of the hypertension are based upon the following propositions: (1) We have seen that clinically cases of hypertension vary from those which have no evidence of disordered kidney function (essential hypertension) to those in which evidences of disordered kidney function are profound (Bright's disease); (2) observation has shown that cases of essential hypertension, unless checked, sooner or later reveal evidence of disordered kidney function and that this progressively increases until the well-recognized clinical picture of Bright's disease is manifest; (3) pathologically, cases of hypertension vary from those which reveal none or slight lesions of the kidney at autopsy to those that show the full-fledged lesions of Bright's disease (contracted kidney); (4) from a morphological viewpoint these lesions, as I have tried to show, reveal a continuous and progressive series, beginning with those kidneys which reveal but slight fibroblastic and glomerular lesions in the cortex to the senescent contracted kidney; (5) the fact that the signs of nephritis may be cured or arrested in early cases by means that restore the hypertension to normal. This would obviously not be possible if we dealt with a primary progressive anatomical lesion.

These propositions, it seems to me, furnish sufficient circumstantial evidence to warrant the deduction that chronic nephritis is a secondary consequence and not a primary cause of hypertension. We are obviously not in the position to watch the transformation of the normal kidney of a case of essential hypertension into the progressive stages of the kidney of Bright's disease; until we can, such reasoning as I have offered must, it seems to me, guide us in obtaining this deduction.

There are, moreover, certain negative evidences that warrant the conclusion that the kidney lesion is not primary: (1) If a primary nephritis were the cause of a hypertension we should expect that the degree of hypertension would be proportionate to the degree of damage to the kidney. This, however, is by no means the case. (2) All experimental attempts to bring about a persistent hypertension by direct injury to the kidney or by removing large portions of the kidney parenchyma have proved futile. (3) Extensive destruction of the kidney by disease, *e. g.*, chronic infections, amyloid disease, subacute bacterial endocarditis, etc., which cause lesions comparable in their morphology to those of Bright's disease, does not result in hypertension. (4) Renal extracts have thus far failed to exert a continuous pressor influence.

The conception of many forms of chronic nephritis as being

due to increased blood-pressure makes me believe that perhaps after all those who have regarded chronic nephritis as a primary vascular disease, *e. g.*, Jores, are probably right. Certainly, no one can deny that lesions of the glomeruli are the most predominant and constant lesions in all stages and varieties of chronic nephritis. If such a conception is granted, arteriosclerosis and chronic nephritis may be considered as having one and the same pathogenesis, the lesion in each being modified by the nature of the organ. This conception requires much clinical, postmortem and even experimental investigation to confirm it. At all events the data thus far at our command seems to make this conclusion extremely probable, and I submit it for consideration.

Having eliminated the vast majority of kidneys associated with hypertension from the category of primary nephritides, what shall we say of those cases of disordered kidney function associated with normal blood-pressure? We shall eliminate at once amyloid kidneys, the kidneys of subacute bacterial endocarditis and the kidneys of acute mercurial poisoning, because this association has been established many times. There still remains a considerable number of cases, the exact nature of which has puzzled me for a long time. These patients consistently pass albumin, show nitrogen retention, have edema, dyspnea, etc., and yet the blood-pressure remains normal. Some undoubtedly belong to the group which Epstein calls "parenchymatous nephritis," the pathology of which is still, according to Epstein, entirely obscure. I am entirely in the dark as to the nature of the pathology of others, and I await an autopsy with intense interest.

The subject of the relation of hypertension to chronic nephritis, or, better said, disordered kidney function, is therefore rich with problems. My attempt to correlate the clinical and anatomical sides, inadequate as it is, will, I trust, serve to show from what aspects some of these problems need be studied, the solution of which may be of vast consequences not only to the understanding of these conditions but of failures of the circulatory system.

ETIOLOGY OF HYPERTENSION. The cause of hypertension has thus far not been satisfactorily explained. In text-books and medical writings most emphasis is placed on chronic nephritis and arteriosclerosis as the main "causes" of hypertension. I think I have shown, however, that the causative relation of chronic nephritis to hypertension is an extremely speculative one, with the strong probability, that it bears only a slight if any relation, and that the clinical findings expressive of a chronic nephritis in our mind represent rather a state of disordered kidney function than an inflammation of the kidney in the anatomical sense. Whatever changes we therefore see in the kidney at postmortem represent injury due to hypertension itself or of the toxin or toxins that cause the hypertension.

The evidence in favor of arteriosclerosis being a secondary con-

dition, due to hypertension and not the cause, is exceedingly strong and to my mind convincing.

The conception of the diseases associated with hypertension as due to "wear and tear" makes an unusual appeal. Such diseases almost always appear and progressively increase in frequency after the middle period of life, and, indeed, as Osler says, "To a majority of men death comes primarily or secondary through this portal;" apoplexy, uremia, cardiac failure and coronary disease account for the majority of deaths past middle life.

To describe a disease as due to "wear and tear" is hardly satisfactory, because such a cause is much too vague and remote. Is it possible to specify the conditions under which "wear and tear" are most likely to occur; are we able to state what elements comprised under the term "wear and tear" bring about these degenerative processes? In other words, why does not hypertension with its associated conditions affect all of us after we have reached the middle period of life?

I here beg leave to submit some observations that I believe bring us somewhat nearer to the solution. I have found that the greatest proportion of patients afflicted with hypertension conform to a certain type, which may be described as both physical and psychic. The patients are overweight and sometimes even obese. The neck is short, the muscles are soft, their bodily movements are sluggish, their carriage and walk are ungraceful and they lack the spring and *elan* of the former athlete. Psychically, these people are tense; they pursue their vocation with tremendous seriousness and worry over trivialities. In consequence they are irritable. Phlegm and hypertension are, in my experience, antagonistic. Furthermore, these individuals have narrow intellectual horizons. Their interest in anything outside of their business is desultory. They have no hobbies. In their leisure hours they play cards, sit in the theater, read the newspapers or rehearse the business activities of the day. Their sleep is not restful and they "do not believe" in vacations. Who cannot recognize in this picture the individual that has been facetiously termed the T. B. M., or "tired business man," whose tastes have activated a large portion of the so-called modern drama? He eats well, drinks alcohol to obtain the stimulation that his mental faculties do not afford, and his most violent daily exercise is his walk to and from the conveyance that takes him to his business. As a rule these people are "successful," and they may be said to die of "success." His most conspicuous mental incapacity is his inability to play. He is no longer a child. I take it that most of us have something of the child within us. Age is not always a matter of years. The greatest tragedy is when the spirit of the child goes early, as so often happens when it is blighted by the premature struggle for existence or the gloom of a depressing environment. Others keep it to a ripe, green age; others, like Peter Pan, never grow up. To be a child is to be able to make believe, to have fancy

and imagination, to be able to take things as they are and not as they think they should be, to live in the present and not in the past, to play lightly with the future, to hear with equanimity the stresses and strains of modern existence, to have ideals, to find some interest in everything, and, above all, to have a sense of humor. What sense of humor is so perfect as that of a child? The child lives in an unreal world and in one of his own making, but who shall say that it is not the only world worth living in? Pity upon him who has no illusions. All these things remain in him who keeps his childhood despite the threat of advancing years. He may be restrained by convention or mellowed by a ripening wisdom, but they are there, coloring his conduct and his philosophy. The child, as he grows older, becomes a sport and always remains a sport. This applies not only to his participation and interest in athletics, but especially in his years of discretion, to his conduct of affairs; he is willing to take chances and accepts the "bludgeonings of chance" calmly and with grace.²

The individual with hypertension, you will find, on the other hand, lacks these attributes wholly or in a large measure, and is mentally and physically prematurely old. To my mind it is the psychical as much as the physical that brings on premature old age. A well-balanced life requires play as well as work, an alkali, if you may so put it, to neutralize the corroding acid of the "fret and fever" in our lives. When a famous clinician said that "we are as old as our arteries," he spoke truer than perhaps he knew.

These influences apply to the rich as well as to the poor, and although I have confined myself largely to the aspects of the problem in man because it is most common in the male sex, women are subject to precisely the same influences. They apply to the laborer as well as to the brain worker, although, for obvious reasons, hypertensive states are more common in the latter—to the professional man as well as to the man of business. I have often thought that the reason why deaths from hypertensive states are less common in those who pursue the arts, literature, music, sculpture, painting, etc., is because in these vocations the element of play is largely mixed.

I think most of us have seen families in which hypertensive states seem almost hereditary. This seems to me readily understandable when one considers that the complex I have described is more directly traceable to environment than to heredity. This is another instance which to my mind indicates that acquired characters are not transmitted in the Weissmanian sense.

Why psychical and physical influences, such as I have mentioned, should bring about a continuous vasoconstriction of the arteries, with its secondary consequences, I cannot, of course, explain. It cannot be mechanically explained by the overweight alone, because

² Roosevelt is the representative of this type. In literature, Barrie, Stevenson, Riley, Field, and Mark Twain expressed the spirit of the child in their writings as no one else ever did.

we know that stoutness alone does not bring hypertension. The theory of Cannon, which supposes that under the stimulus of mental excitement the adrenalin content of the blood is increased, with occasional glycosurias, is very alluring for purposes of explanation. Unfortunately, the work of Cannon has not been confirmed. Furthermore, it has been definitely shown that small increases in the blood adrenalin do not cause an increase in tension, but the reverse. In this connection I cannot resist the temptation to add that in my experience many patients with diabetes have the precise mental character that I have described above and that hypertension and certain forms of diabetes possess many parallel clinical features. Why the same cause should lead to diabetes in the one and to hypertension in the other I am at a loss to explain.³

Obviously, I am not trying to account for all cases of so-called essential hypertension by this etiology. Once in a while, if rarely, we do meet people with hypertension who do not conform to the complex I have mentioned. I recall patients, for instance, whose malady seemed to be directly traceable to syphilis, to lead and to scarlatina. Even in such instances may it not be possible that the poison is primarily vasoconstricting and that the arterial and kidney lesion is a secondary phenomenon?

There may be other vasoconstricting influences than that which I have described, but, at all events, I hold that the vast majority of patients with hypertension will be found to conform to this type.

CONCLUSIONS. 1. A persistent hypertension represents, in the strictest sense, a decompensation of the circulation. Moreover, the subjective and objective phenomena of decompensation represent a progressive process, and every persistent hypertension, unless complicating factors are introduced, will eventually result in the graver evidences of decompensation represented by the clinical picture of cardiac insufficiency.

2. The signs of decompensation may be both subjective and objective and there is only an approximate parallelism between the two. Subjective improvement or deterioration does not always correspond to objective improvement or deterioration and *vice versa*.

3. Many early cases of essential hypertension, in which both systolic and diastolic pressure are not too high, are as far as present observations lead one to believe, entirely curable.

4. The conventional classification of hypertension into essential arteriosclerotic and nephritic is not justifiable on etiological grounds. Such a classification is merely clinical and teleological. On such a basis, the classification should include the cerebral, cardiac (coronary) and aortitic types in addition to the above.

³ These same psychic influences may serve to explain why hypertensive states are so very commonly the causes of death in physicians, as the annual reports in the Journal of the American Medical Association eloquently testify. Owing to the strain of their vocation, physicians are extremely apt to fall into the state of mind I have described and for the same reason take little physical exercise,

5. The vast majority of disorders associated with persistent hypertension begin as "essential" hypertensions. If untreated such essential hypertensions lead to the clinical concepts of arteriosclerotic, nephritic and other hypertensions.

6. All available evidence at present under our command seems to show that arteriosclerosis (with the possible exception of the "decreascent" form of Clifford Allbutt) is the result of the hypertension itself or (less likely) of the cause that brought about the hypertension.

7. Albuminuria is not necessarily the result of injury (even profound) of the kidney parenchyma. Badly diseased kidneys may be present without albuminuria.

8. The albuminurias associated with cardiovascular disorders (valvular heart disease, hypertension, etc.), are more the result of static circulatory changes within the kidney than to direct injury of the kidney parenchyma. Which forces in the dynamics of the circulation bring this about we can only surmise.

9. Functional tests of kidney function have thus far only furnished us with a biological classification. Both clinical signs and functional tests do not permit us, except in a limited degree, to diagnose the anatomical "type" of nephritis that will be found at autopsy.

10. A hypertension may occur with normal kidneys or kidneys practically normal.

11. The confusing nomenclature and classification of "types" of chronic nephritis is due to the fact that the attempt has been made to define each "type" as the result of a specialized form of injury. Evidence is adduced to show that the majority of these various "types" are the stages of one and the same pathogenesis. Such types are therefore not end-results, with the exception of the "contracted" kidney. The "type" of kidney we shall find at autopsy depends upon that period in the pathogenesis of his malady in which the patient succumbs.

12. Evidence is adduced to indicate that in many instances at least, the pathological changes in the kidney of Bright's disease are the results rather than the cause of hypertension. Such a conception would render it very probable that the hypothesis of the primary vascular origin of the lesions in the kidney in Bright's disease is correct. Arteriosclerosis and Bright's disease have therefore the same pathogenesis, the lesion in each being modified by the nature of the organ.

13. The direct etiology of hypertension is unknown. However, a type of person is described, conforming to certain physical and psychic complexes, in whom hypertension is very likely to occur. This type is the antithesis of the child, both in mind and spirit. A knowledge of this type may prove of value in prophylaxis.

MENINGO-ENCEPHALITIS AS THE ONLY MANIFESTATION OF MUMPS: REPORT OF THREE CASES.

BY TASKER HOWARD, MAJOR, M.C.,

BROOKLYN, N. Y.

CHIEF OF MEDICAL SERVICE, BASE HOSPITAL, CAMP LEE, VA.

DURING the past winter, at Camp Lee, we have been afforded a rare opportunity of studying mumps in adults. Nine cases of cerebral complications in frank cases of mumps have been encountered and have been made the subject of a special report by Lieut. R. L. Haden,¹ who has had the supervision of the Contagious Disease Service.

These cases were characterized by the occurrence, during an attack of mumps, of increased temperature, headache, vomiting and frequently evidence of cerebral disturbance, as stupor, delirium, etc. Lumbar puncture usually showed a moderate pleocytosis of a mononuclear type, and the physical signs of a mild meningitis were usually present. Haden shows that in some cases evidence of any meningitis is lacking and in most others the accompanying encephalitis is the predominating factor, and concludes that the cerebral complication of mumps is mainly an encephalitis rather than a meningitis.

The object of this paper is to put on record the history of three cases which exactly parallel the frank cerebral complication of mumps as observed at this hospital, except for the absence of involvement of the salivary glands or testes.

Metastatic lesions in mumps are well known, testifying to the general nature of the infection. Orchitis, mastitis, pancreatitis, arthritis, encephalitis and meningitis are at times met with. Furthermore, during an epidemic at least one of these complicating conditions—orchitis—is at times recognized in the absence of any involvement of the salivary glands. There is therefore no reason to doubt that one or more of the other unusual manifestations of mumps infection may occur without salivary gland involvement.

The three cases reported below are regarded as instances of mumps meningo-encephalitis, in spite of the absence of inflammation of the salivary glands, for the following reasons:

1. They occurred in the presence of a mumps epidemic.
2. Two of the patients had never had mumps, while the third (Case II) had been told by his father that he had had mumps, but could not remember it himself.
3. They all presented mild symptoms of meningo-encephalitis, which were entirely relieved or much ameliorated by spinal puncture.
4. In two of the three cases (Cases I and III) there was recovered from the spinal fluid a Gram-positive diplococcus. This was found

¹ Arch. Int. Med., 1919, xxiii, 737.

in direct smear and grown in pure culture in both cases. In Case III it was found in smear three times and recovered in culture twice.

That mumps is due to an organism of this description has long been believed, and further evidence to this effect is adduced by Lieut. Haden from evidence accumulated at Camp Lee.

5. The spinal fluid in each case presented a moderate pleocytosis, characterized by a predominance of mononuclear cells. The conditions with which we are familiar, which show this picture, are (a) syphilis, (b) sometimes tuberculous meningitis, (c) encephalitis lethargica and (d) mumps.

(a) As to syphilis, two of the patients were negative serologically and the third (Case III) while having a positive Wassermann, repeatedly showed the presence of a Gram-positive coccus in the spinal fluid. Thus two of the three patients were certainly not syphilitic and the third certainly had some infection besides syphilis.

(b) Tuberculous meningitis is ruled out in all cases by the clinical course.

(c) The same may be said of encephalitis lethargica, there being no cranial nerve involvement and no palsies of any kind. There was also lacking the increase of tendon jerks which was almost uniformly present in the cases of this disease which we have observed.

Unless we presume to hypothecate some unknown type of infection, we are forced by exclusion to consider the three following cases as meningo-encephalitis due to mumps.

CASE I.—D. W. M., Sgt., Q. M. C. (4630924), admitted to hospital March 24, 1919; aged twenty-one years, white; seven months service; a native of Washington, D. C. His premilitary occupation had been that of a clerk.

The family history was negative; his parents, a brother and two sisters being alive and well.

Previous Personal History. In childhood he had had measles, whooping-cough and scarlet fever, which was followed by mastoiditis. At thirteen he had had grip. He stated that he had never had mumps. He denied venereal disease.

History of Present Disease. For a week before admission to the hospital he had had a dull headache and felt dizzy at times, but had remained on duty. There had been no disturbance of vision and no complaint of digestion or respiratory symptoms. He stated that he had had fever for one day and the headache had become more severe.

On admission, 8.30 P.M., his temperature was 99.8°, pulse, 78; respiration, 18. Physical examination was essentially negative. The next morning the temperature was 101.4°, with a pulse of 80. The pupils were equal and reacted to light. Extra-ocular movements were normal. The tongue was protruded in the median line and there was no muscular weakness of the face or elsewhere. Forced

flexion of the neck was a little painful and induced drawing up of the knees. The tendon jerks—biceps, patella, Achilles—were symmetrical and normal, as were the abdominal and cremasteric reflexes. There was no Kernig and no Babinski. The chest and abdomen were negative.

The throat was slightly injected. There was no eruption on the skin. There were 9000 leukocytes, the differential showing 69 per cent. polymorphonuclears; 21 per cent. lymphocytes; 9 per cent. large mononuclears and 1 per cent. transitionals. The urine was 1.030 specific gravity, and showed a faint trace of albumin, a few leukocytes and amorphous urates. Blood culture was negative.

Lumbar puncture showed the spinal fluid to be under moderate tension and 25 c.c. were removed. The fluid was clear and contained 360 cells per c.mm., of which 99 per cent. were mononuclears. The test for globulin was reported negative and the Wassermann was negative. In the smear were found Gram-positive diplococci, which were grown in pure culture.

The patient was much more comfortable after the spinal puncture. His temperature was 99° the next day and remained normal there after. He was discharged to duty April 8, 1919.

CASE II.—G. H. H., Jr., Sgt., Medical Corps (1845685), admitted to hospital May 11, 1919; twenty-five years of age, white; two years and two months service; a native of Kentucky. Before enlistment was a railway messenger.

Family History. Father living and well. Mother died of typhoid fever.

Previous Personal History. Inflammatory rheumatism at the age of nine. Patient stated that his father told him he had had the mumps at the age of nine, but that he did not recall having had the disease. He had had an appendectomy and an operation for hemorrhoids one year ago. In 1917, before entering the service, he had had a "scratch" on his penis, and although he had never had any symptoms of syphilis and never had a Wassermann done, he had taken several doses of salvarsan "to be on the safe side."

Present History. The day before admission he began to feel very tired and complained of pain in the head and back. The following day he felt much worse and complained of pain in all his joints and stiff neck.

On admission his temperature was 100.8°; pulse, 76; respiration, 18; and he was very uncomfortable. The pupils and extra-ocular muscles showed no abnormality. The neck was stiff. The tendon jerks and skin reflexes were normal and equal. There was a definite Kernig's sign on both sides, which was more marked later. There were no palsies. The chest and abdomen were negative. The throat was somewhat reddened. The skin showed no eruption and the glandular system was negative.

There were 16,400 leukocytes, of which 78 per cent. were poly-

morphonuclears, 15 per cent. lymphocytes and 7 per cent. large mononuclears. The urine was 1.016 in specific gravity and contained no albumin or casts. Blood culture was sterile. Wassermann was negative.

Lumbar puncture showed the spinal fluid to be under considerable pressure and slightly turbid. It contained 703 cells per c.mm., of which 90 per cent. were mononuclears and 10 per cent. polymorphonuclears. Globulin was present. Smear and culture showed no organisms.

Wassermann was negative. The patient was given 30 c.c. of antimeningococcic serum at the time of the first puncture. He improved rapidly, his temperature never exceeding 99° after the second day and remaining normal after the fifth. The stiff neck and Kernig's sign persisted for about ten days. A second spinal puncture was done on May 14. The fluid this time showed 530 cells, of which 80 per cent. were small mononuclears, 18 per cent. large mononuclears and 2 per cent. polymorphonuclears. Globulin was increased. Sugar was present. Smear and culture disclosed no organisms.

This patient's recovery and convalescence were less prompt than in the case of the first patient, but he was discharged to duty in good condition on June 5, 1919. He received no antiluetic treatment.

CASE III.—J. M., Sgt. 1/c. Q. M. C. (1843176), aged twenty-nine years; one year and nine months' service; a native of New York, was admitted to the hospital, April 19, 1919.

Family History. Father, mother and four sisters living and well.

Previous Medical History. Had gonorrhea three times prior to entering the service. About four months previous to admission had a venereal sore. A Wassermann was found to be ++ and he was given nine injections of salvarsan and eight of mercury, the treatment lasting up until shortly before he came into the hospital. In January, 1919, he was kicked in the back by a mule, but this caused him practically no symptoms.

History of Present Disease. About a week before admission to the hospital he began to suffer from a boring pain in the small of the back, occurring in the early morning hours. After entering the hospital he complained also of headache. There were no other symptoms. His temperature was normal and has remained so except for an occasional rise to 99° and once to 100°. The pulse and respiration were normal. No local pathology was found to explain the painful back. The Wassermann was negative and no focal infection could be found. The urine showed a faint trace of albumin and a few leukocytes. There were 4,000,000 erythrocytes, 7200 leukocytes, of which 59 per cent. were polymorphonuclears, 18 per cent. small mononuclears, 19 per cent. large mononuclears, 2 per cent. eosinophiles and 2 per cent. basophiles.

On April 29, 1919, examination showed pupils equal and active. Extra-ocular movements normal, other cranial nerves negative. Slight stiffness of neck. Some resistance on extending leg on flexed thigh, but no pain. Deep reflexes normal. Abdominal not obtained. Babinski negative.

A lumbar puncture showed no increase of pressure, but the fluid was slightly turbid. It contained 2500 cells, all lymphocytes, globulin present, sugar negative, Wassermann ++ (0.5 and 1 c.c.). On smear and culture was found a small Gram-positive diplococcus. The data obtained on repeated punctures is shown in the table. The headache and backache were relieved shortly, but after about a month the pain in the back recurred. He has received no anti-leptic treatment while in the hospital, in spite of which the Wassermann steadily declined in intensity and the number of cells markedly decreased. It seems probable that the presence of a secondary infection actuated a latent syphilitic lesion, and with the subsidence of the former it is planned to begin active treatment. (See Table.)

SPINAL FLUID FINDINGS IN CASE III.

	April 29.	May 5.	May 14.	May 26.	June 5.
Cell count per c.mm.	2500	1200	390	140	300
Mononuclears, per cent.	100	100	98	100	
Globulin	+	++	+	+	±
Sugar	0	0			
Organisms on smear	+	+	+	—	—
Organisms on culture	+	+	—	—	—
Wassermann, 0.5 c.c.	++	++	+	+	—
Wassermann, 1.0 c.c.	++	++	++	++	+

MYXOMA OF THE HEART SIMULATING BRONCHOPNEUMONIA.

BY WILLEY H. NORTON, MAJOR, M.C.

MT. CLEMENS, MICHIGAN.

(From the Base Hospital Laboratory, Camp Jackson, S. C.)

THE presence of primary neoplasms of the heart usually presents during life such obscure symptoms that little has been written upon the subject. Most text-books pass the subject over in a few words, which, summed up, amount to saying that it is impossible to make the diagnosis or that it is only made by exclusion. In view of the fact that modern surgery makes intrathoracic surgery a comparatively safe procedure, I feel it is essential to report all such cases in detail in the hope that eventually a symptom-complex for cardiac tumors may be worked out.

Private J. S., aged twenty-nine years, white, was admitted to the hospital October 8, 1918, with the diagnosis of pneumonia. The family history was negative. As a child he had diphtheria, scarlet

fever and pertussis, and three years ago an appendectomy followed by a laparotomy for intestinal obstruction. Two weeks before admission to the hospital the patient was observed by two comrades, who said he fainted twice at drill and on other occasions had to fall out of ranks when double-timing on account of shortness of breath and palpitation of the heart. The patient stated his present trouble began two weeks ago with a cold and a cough. The day before admission to the hospital, after a wrestling match, he began coughing a great deal and raising a considerable amount of blood, which became rusty on the following day. There was some abdominal pain and a burning sensation in the epigastrium, which gradually became more severe. No chill or pain in the chest. No nausea or vomiting. From that time breathing gradually became more difficult.

On admission the temperature was 99.4° , the pulse 146 and the respiration 52. Three hours after admission physical examination showed a well-built man with an anxious expression to the face. He was moderately cyanosed, was breathing rapidly and had a moderately accelerated pulse, but regular and of fair volume. The size and position of the heart were normal, the P. M. I. was in the V. i. c. s. inside the nipple line. No murmurs were heard. The muscular quality of the first sound at the apex was impaired and diastole shortened. The white blood count showed 17,800, of which 17 per cent. were small mononuclears, 7 per cent. large mononuclears and 76 per cent. polymorphonuclear neutrophils.

There was impaired resonance with bronchovesicular breathing and slightly increased voice sounds over the right front down to the third rib. Similar but less distinct signs over the left front were observed and numerous medium and fine rales over the entire chest were heard. The opinion at this time was:

I. Acute toxic myocarditis.

II. Bronchopneumonia.

Eight days later the cardiac and lung conditions were much improved; the color was good. The pulse was slower and the breathing was slower and easy. The lungs were practically clear and the temperature normal.

On October 22 the temperature was 99° A.M., 100° P.M.; the pulse was 82, regular and good volume. His mind was somewhat confused and he was excited. The pupils were unequal, the right being larger than the left; both reacted, however, to light and accommodation. There were a few crepitant rales at the left base.

On October 24 the patient's orientation was a little disturbed; he had some delusions and at times was morose and would not answer questions. The pupils were still unequal, the right not reacting to light and the left only slightly. The tongue protruded in the midline. The knee-jerks were equal. There was a right ankle-clonus. The lungs were clear on auscultation and percussion. The heart apex was in the fifth interspace inside the

nipple line. No murmurs were heard. The pulse was soft, regular and 84 per minute.

The spinal fluid on this date showed three white blood cells and gave a negative Wassermann reaction. A white cell count showed 10,700, of which 17 per cent. were small mononuclears and 83 per cent. polymorphonuclears. The urine was negative except for mucous shreds and calcium oxalate crystals. The temperature, pulse and respiration were normal.

October 31, patient was seen by a psychiatrist and a tentative diagnosis of dementia precox made.

November 18 the patient tried to drink creolin, but apparently did not get more than a swallow. Prompt treatment was followed on the next day by apparently his normal condition.

November 20 a few rales were observed at the base of the right lung. The heart was normal to auscultation and percussion.

November 27 the patient was again examined by a psychiatrist, who made the following statement: "He had a severe attack of pneumonia, beginning about October 8, 1918, which was followed by the manifestations of his present trouble. There have been no injuries which have a bearing on his present trouble. He is well-nourished. There are no paralyses, tremors or tics. There is no disturbance of gait or station. The K. K. are increased but equal. The abdominals are present and there is no Babinski. The pupils are widely dilated, equal, regular and have a prompt but rather narrow reaction; there is neither nystagmus nor diplopia. There is no demonstrable disturbance of cutaneous sensation.

During the convalescent period from pneumonia this man developed a mild depression, auditory and visual hallucinations and ideas of persecution and poisoning, all of which have persisted up to the present time and have been slightly on the increase. His reaction to these has been one of depression and apprehensiveness, and on one occasion he attempted suicide by taking a mouthful of creolin. His memory and orientation are quite disturbed, and he has no insight. Retardation and blocking of thought are much in evidence. Diagnosis: Dementia precox."

December 28 the temperature was 97°, the pulse 120 and the respiration 28. Over the left upper chest in front, just outside the nipple line, a patch of high-pitched breathing was observed; lower down just below the apex of the heart a second patch of near-bronchial breathing, and over the right upper chest numerous large moist rales were observed.

December 29, exitus.

Temperature	98.2
Pulse	118
Respiration	40
White blood cells	48,400
Polymorphonuclears	95 per cent.
Small mononuclears	3 "
Large mononuclears	2 "

AUTOPSY. The patient was a well-built and fairly well-nourished man, 5 feet 10 inches in length. There were a few fragile adhesions in both pleural cavities, but no fluid. The pericardial sac contained 80 c.c. of clear, yellowish fluid. The peritoneal cavity was free from fluid or evidence of recent inflammation. The lungs were voluminous and firm, the right more so than the left, but both gave a slight crepitus everywhere on palpation. The cut surface was like liver tissue in consistency, and was dripping wet with fluid. The tissues were everywhere air-containing and blocks floated in the fixing fluid. The other organs showed the usual picture produced by back pressure. The brain and cord were not examined. The heart was enlarged, weighing 510 grams. The left auricle was filled by a tumor mass which was implanted by a broad base on the auricular wall. It was made irregular by polypoid-like growths, apparently growing in the line of least resistance, bulging the fossa ovalis into the right pulmonary vein, another into the mitral orifice and so completely filling the cavity that it was difficult to pass a small flexible probe between the tumor and auricular wall into the left ventricle. Thus a very effective resistance to the flow of blood in either direction was formed, owing to the pressure of the tumor against the distended elastic auricular heart muscle.

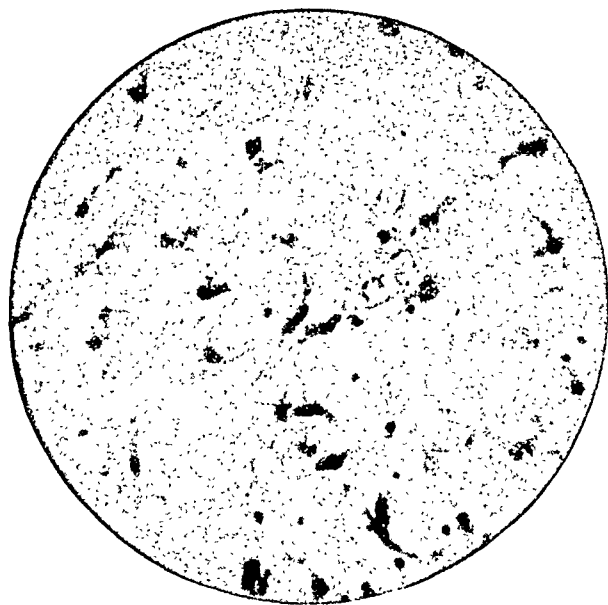


FIG. 1.—Photomicrograph. Showing spindle- and stellate-shaped cells. $\times 430$.

The tumor was composed of two distinct portions, but attached to each other. The upper portion, which was quite firm but elastic, was attached to the heart wall, while the lower portion, which was comparatively soft and gelatinous, was an outgrowth from the hard portion and hung free from the heart wall. The harder portion

came down to the level of the coronary artery and the smaller and softer portion extended below the coronary artery, hanging as a free plug between the mitral valves. It measured 9.5 cm. in length and 8.5 cm. in its widest diameter. Complete closure of the mitral valves was impossible, and there was no reason why a regurgitant murmur should not have been produced except in so far as the ball-and-socket action of the tumor served that purpose,

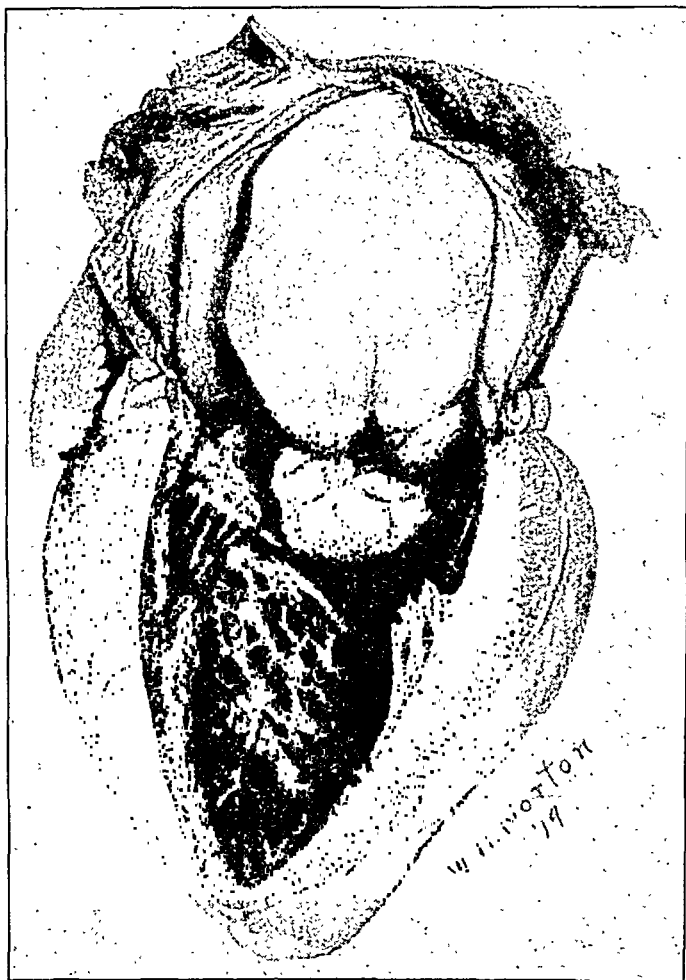


FIG. 2.—Showing the shape and position of the tumor, with reference to the valves. $\times \frac{2}{3}$.

together with the distended auricular wall pressing against the tumor. The left ventricular wall was normal in thickness and the right was hypertrophied. The valves were normal. The tumor was covered by endocardium. On cross-section the tumor showed a preponderance of white, fibrous-looking tissue in the larger portion, but scattered here and there through it and preponderating in the smaller portion were rather clear dark-looking areas having a distinct jelly-like appearance. These latter areas

were quite definitely better supplied by bloodvessels than the white, fibrous-looking tissue and were definitely elastic.

Microscopic examination of sections in this case showed edema of the lungs and passive congestion of the liver, spleen, pancreas, kidneys and adrenals. The heart section showed the pericardium, myocardium and endocardium normal, with the exception that the endocardium over the tumor was thickened and the tumor growth immediately adjoining the muscle shows remnants of muscle bundles in among the fibrous and connective tissue. Deeper into the tumor there was a decrease in the number of cells having nuclei, although this varied, and there was a preponderance of granular intercellular substance taking a blue stain-like mucin. The cells in these areas were fusiform and stellate, one finding two, three and occasionally four protoplasmic processes to one nucleus. These areas were well supplied by bloodvessels filled with blood, which had a definite endothelium and elastic tissue in the walls. The elastic tissue was best shown by Mallory's elastic tissue stain. There were two other types of cells found: a few small round cells, with very little protoplasm and larger cells, with a slightly irregular nucleus and a nucleolus showing scarcely any protoplasm. In some places the cells were thick, in others scattered, forming strands in among the blue-stained portion. The round and oval nuclei were stained an intensive blue. These cellular elements were spread out over the entire section—in some places thick, in others thin. While the cellular areas were sometimes found in the rim portion they were most common in the central portion of the tumor. Between the cellular areas, but mostly around the periphery of the growth, one found eosin-staining tissue poor in nuclear elements and having definite wavy tendrils. In some portions considerable hemosiderin was found. There were a few areas in which small hemorrhages had occurred. The vessels were, for the most part, found in the areas with the greatest number of cells while the hemorrhagic areas were most often found in the rim portion. With the high power in those places where the cells lay closest together one found cells with long nuclei approaching the spindle cell in type and in between these cross-sections of cells which resembled round cells. Situated around the rim of the above-mentioned cell groups were star-shaped cells, with oval nuclei whose protoplasmic processes appeared to communicate with one another.

Here also were cells whose nuclei were definitely undergoing degeneration. These cells were probably degenerated myxomatous tissues which formerly were the above-mentioned spindle-shaped cells. Between these cells there was a fine-grained intercellular substance taking the blue stain with hematoxylin. Outside of these areas one found fibrous and connective tissue in which small hemorrhages were noted. Throughout the tumor elastic fibers could be seen. A few of the bloodvessels contained some fibrin.

The vessels were lined by a single layer of cells, and with an elastic tissue stain some of them showed a small amount of elastic tissue. They were, for the most part, filled with red blood cells.

While some might make a diagnosis in this case of fibromyxoma, I prefer to call it a true myxoma. There does not seem to me any more reason for calling a myxoma a fibromyxoma than there is for calling a carcinoma a fibrocarcinoma. Undoubtedly in this case there is considerable fibrous tissue present, but it is evidently replacing the degenerating myxomatous tissue. Thorel believes that myxomata are merely degenerating forms of organized thrombi. The chief arguments against this view are:

1. The presence of elastic tissue throughout the tumor.
2. Organized thrombi tend to contract and become smaller.
3. If they are organized thrombi and grow the oldest or densest scar tissue would be in the center of the tumor, which would be contrary to the usual procedure of organizing thrombi.
4. Why should 75 per cent. of all intracavitary tumors be localized in the left auricle when thrombi are equally as frequent in the ventricle as the auricle.

Myxomata form about 30 per cent. of all primary tumors of the heart if the reported cases can be relied upon as being correct. Unfortunately some of the cases reported are so brief that it is impossible in many cases to judge from the descriptions what was the nature of the tumor. Hektoen calls attention to the fact that the heart and hence its primary tumors are of mesoblastic origin. Hence it would necessitate a complete description before one could determine that a tumor was epiblastic or hypoblastic in origin.

DISCUSSION. Link proposes to divide primary tumors of the heart into four groups for the study of their clinical symptomatology as follows:

Group I. Tumors developed in the auricles. The characteristics of these neoplasms is to produce a very marked stasis in the lesser as well as the greater circulation. During life it may have been impossible to explain this stasis, which did not depend upon any ordinary cause.

Group II. Comprises pedunculated tumors arising in the left auricle filling its cavity and sometimes penetrating through the mitral orifices into the left ventricle. These tumors produce symptoms of stenosis and insufficiency with disturbances of compensation. The signs here on auscultation are very variable and change with the position of the patient.

Group III. This group is composed of tumors having as their principal seat the right ventricle. The symptoms have been about the same as those of angina pectoris, with sudden death.

Group IV. In this group are placed tumors of the left ventricle and tumors of the valves where edema, dyspnea and undoubted

signs of aortic insufficiency were present. These patients die a sudden death without having offered any special symptoms during life.

Meroz in his paper proposes to group cardiac tumors for study according to their site:

1. Valvular tumors.
2. Intramuscular tumors.
3. Intracavitary tumors.
 - (a) Sessile.
 - (b) Pedunculated.

He summed up his observations by saying that primary tumors of the cardiac valves remain either silent and unsuspected or else produce phenomena of stenosis or insufficiency. Primary intramuscular tumors on examination reveal nothing or almost nothing which can explain the clinical manifestations. Sessile intracavitary tumors of the left heart can in no way be distinguished from organic cardiac affections. The pedunculated intracavitary growths are to be distinguished from organic valvular affections of the heart by producing an exceptional continued intense dyspnea, for which no satisfactory explanation can be given; by producing rather indistinct and particularly very variable signs of insufficiency or stenosis and lastly by the production of multiple emboli.

In the case herein reported the symptoms of stasis in the lesser as well as the greater circulation would cause one to place it in Link's Group I, with the exception that the physical signs and leukocyte count on admission would lead one to make a diagnosis of bronchopneumonia in spite of the fact that the temperature was never high and most of the time perfectly normal. Hence we cannot say with Link that during life it was impossible to explain this stasis. Link's Group II comprising pedunculated tumors arising in the left auricle filling its cavity and sometimes penetrating through the mitral orifice fits the location of this case exactly. However, Link's Group II calls for symptoms and signs of stenosis and insufficiency with disturbances of compensation. The only symptoms corresponding to this classification were cyanosis, dyspnea and palpitation, while there were no signs of stenosis or insufficiency on auscultation. As regards Meroz's classification, this case would be placed in the group of pedunculated intracavitary tumors; however, there was no continued intense dyspnea, no signs of insufficiency or stenosis and at no time any indication of embolism—in fact, none of the distinguishing features as outlined by Meroz were present.

Bodenheimer says the symptomatology of cardiac tumors is still a vast field open to investigation, that the symptoms produced are not precise or well defined and that they depend upon the size of the tumor. If it occupies a position which interferes with the heart's action it will set up phenomena of stenosis or insufficiency and the diagnosis can be made only by exclusion.

Berthenson states that in cases in which the clinical picture of the disease is indistinct and presents deviations from the normal type which cannot be accounted for, multiple emboli may give rise to the idea of a cardiac tumor. Ely insists on the fact that primary tumors of the heart do not give rise to much if any disturbance nor to any characteristic symptoms. Fränkel maintains that a pericardiac hemorrhagic fluid collection recurring quickly after puncture when the patient is not in receipt of a traumatism, and has neither tuberculosis nor scurvy, almost certainly indicates the presence of a cardiac neoplasm. Victor Petit emphasizes the fact that the symptoms are intermittent, one may hear a murmur, but its intensity and location may vary or it may appear then disappear altogether. In addition to the above facts we have to consider the fact that some cardiac tumors are never recognized or give no indication of their presence either on account of their size or their location. Such cases either result in sudden death without previous symptoms and are recognized at autopsy or are incidentally found at autopsy during examination for some other affection.

By taking a number of cases in which the histories are adequate and the patients gave symptoms and making a composite picture there is at once noticed an overlapping of certain diagnostic points. These points are dyspnea, general weakness, anemia, depressed mental condition, palpitations of the heart, a pulse of low tension and variability of all signs and symptoms. In many of these cases there may have been some overshadowing symptom, such as intense precordial pain, intense distress, with no relief except when sitting on the edge of the bed with the feet hanging down or signs of stenosis or insufficiency. None of these cases presented all of the symptoms at one time and all of them varied from day to day and week to week; this applies not only to the minor symptoms but to the major symptoms as well. It would appear then as if it were impossible to make the diagnosis of heart tumor from one examination that it must be made from a composite picture perhaps made up from several days' or weeks' observation. I agree with Victor Petit that the intermittent character of the symptoms should be emphasized most. Organic heart lesions like stenosis or insufficiency do not produce symptoms one day only to disappear on the next.

The variability of the symptoms must be dependent at least to some degree upon the position of the tumor, with reference to the blood flow; if the pedicle of the tumor is long it is easy to see how, as Petit suggests, the variability depends upon a torsion of the pedicle; in my case, however, the pedicle was so broad and thick that there was no possibility of torsion occurring. There was so much dilatation of the auricle from the tumor growth that the muscle must have been constantly giving away from necessity to accommodate the tumor and to allow the blood from the lungs to

pass through the auricle partially forced by the blood-pressure in the lesser circulation and partially by the dilatation occurring during diastole. As noted in the pathological examination, there was a polypoid-like growth developing into the lumen of the right pulmonary vein, introducing more resistance to the blood-flow from the right lung, hence the more marked signs on auscultation over the right chest.

If the intermittent character of the symptoms is in any way due to the accommodation of the anatomical structures to the size of the tumor then the nature of the tumor and its rapidity of growth would have an important bearing on the return of symptoms.

THE BACTERIOLOGY OF MUMPS: REPORT OF FINDINGS AT CAMP LEE.

BY RUSSELL L. HADEN, LIEUT., M.C.,

DETROIT, MICHIGAN,
BASE HOSPITAL, CAMP LEE, VA.

It seems surprising that so little is known about the virus of mumps. The disease is so common, so widely distributed and so prone to occur in epidemic form wherever numbers of people are collected together that one could expect to find numerous bacteriological reports of the disease in the literature. An unusual opportunity has been afforded in the army camps for a study of the disease. However, the mildness of its course and the fact that spontaneous recovery is the almost invariable outcome have largely removed the incentive for research work on its cause.

From time to time observers have isolated bacteria from the blood, the parotid secretion and the testis of patients suffering from mumps. The organisms recovered have been quite uniformly Gram-positive diplococci, which grow slowly in cultures, usually not appearing for forty-eight hours. Attempts to reproduce the disease with the cocci isolated have been for the most part fruitless. Herb¹ reports the recovery of a Gram-positive diplococcus from the heart's blood and tissues of a patient dying subsequent to an attack of mumps. This organism corresponded culturally with the cocci previously described by other investigators, and when injected into the parotid gland of a dog, caused a parotitis simulating mumps. The injection of cultures intraperitoneally also produced an orchitis.

More recently the view has been prevalent that the disease is caused by a filterable virus. This view is due largely to the failure of investigators to constantly reproduce the disease in animals with the organisms isolated. Wollstein² believes that the cocci which

¹ Jour. Am. Med. Assn., 1908, li.

² Jour. Exper. Med., October, 1918.

have been described are really all contaminations. She has injected cats with both the filtered parotid secretion and the blood of patients suffering from mumps, and considers that the results obtained justify the conclusion that the disease has been reproduced. However, the results are not striking, and there seems a reasonable doubt, from the description given, whether the condition produced by filtered secretion on injection was in reality the disease.

The bacteriological findings in several cases observed in the base hospital at Camp Lee seem to throw some light on the nature of the virus of mumps. Unfortunately this work was not started until the epidemic was almost over and there were few cases being sent in from camp. Our attention was first directed to the subject by the findings in the spinal fluid from a patient under treatment for mumps. This was one of a series of 9 patients who showed signs of a cerebral complication occurring during the course of the disease. A detailed report of these 9 cases is to appear elsewhere.³ The spinal fluid showed uniformly a pleocytosis of the mononuclear type, very little or no globulin, a positive sugar reaction and a negative Wassermann test. Cultures and smears were negative in 8 cases. In one instance the fluid was opalescent and the findings the same as in the other fluids, except that smears showed numerous Gram-positive diplococci. No growth could be obtained on culture, and rabbits injected intraspinaly were negative. All 9 patients exhibited clinically classical mumps, and the one case in which the organisms were found differed in no way from the other 8. The cocci were found in direct smear, so there was no chance of contamination. The fluid showed the same pathological features, so we see no reason to suppose that this patient had a secondary infection. It seems reasonable to conclude that the organism demonstrated in the spinal fluid was the one causing the primary infection, a parotitis.

After the finding of this organism in the spinal fluid we began to do blood cultures routinely on all cases of mumps on admission to the hospital. A total of twenty-five cultures was taken on eighteen patients. The cultures were made in dextrose and plain infusion bouillon. Nineteen cultures were sterile. Two were contaminated. Four cultures on three different patients showed a small Gram-positive diplococcus. The growth in broth was very slow. When transferred to blood-agar plates, organisms appeared in forty-eight hours in very small, dew-drop colonies. After several transplants it grew readily on all media. No pigment was produced on the blood-agar.

In the fifth case reported the blood cultures were negative, but the same diplococcus was grown from an inguinal gland, which became swollen subsequent to a very severe orchitis.

The histories of the patients from whom the organism was recovered are given in detail below.

³ Arch. Int. Med., June, 1919.

CASE I.⁴—L. P., Pvt., Co. 2, 3d Bn., 155 D. B., aged twenty-five years, white, was admitted to the Base Hospital March 2, 1919, complaining of swelling of the left side of his face. He had had the usual exanthemata of childhood and pneumonia in 1918. On the day before admission he began to have pain and swelling of the left side of the face. Physical examination was negative except for swelling of the left parotid gland. His temperature was 100°, pulse 100 and respiration 20. On March 5 the right parotid became involved. His temperature returned to normal. On the next day he began to have a severe headache, which continued for two days, with temperature going as high as 103.6°. When seen on March 8 he was having severe headache and vomiting. He had no orchitis. The parotid swelling had practically disappeared. There was slight but definite stiffness of the neck and a slightly positive Kernig. The cranial nerves were negative. No deep reflexes could be obtained except the left biceps tendon reflex. The Babinski was negative. There was no clonus. Lumbar puncture showed an opalescent fluid under increased pressure. Following the puncture his temperature returned to normal and all symptoms rapidly cleared up. His recovery was uneventful. He was discharged to duty March 17, 1919. The spinal fluid showed 440 cells per c.mm., of which 100 per cent. were mononuclears. The sugar reaction was positive and a globulin test slightly positive. A direct smear showed Gram-positive cocci, but no growth was obtained on culture. Rabbits injected intraspinaly with the fluid were negative.

CASE II.—G. A. S., Pvt. Co. A, 407 Res. Labor Bn., aged twenty-seven years, colored, was admitted to the hospital April 2, 1919, complaining of pain and swelling of both sides of the face. His family history was negative. He had had measles, chicken-pox, diphtheria and pneumonia. His present trouble had begun the day before admission and had gotten steadily worse. On admission there was extreme swelling of the parotid region on both sides. His temperature was 99.1°, pulse 84 and respiration 18. Physical examination was negative otherwise. The next day his temperature was 99.6°, and on April 5 it was 99.4°. Thereafter it was normal. A blood culture taken on the day of his admission showed a Gram-positive diplococcus. A second culture taken the following day revealed the same organism. The soldier had no complication and made an uneventful recovery. He was discharged to duty April 15, 1919.

CASE III.—D. S. B., Sgt. Util., Q.M.C., aged twenty-five years, white, was admitted to the hospital April 7, 1919, complaining of pain and swelling of both jaws. His family history was negative. He had had measles, chicken-pox and influenza. His present trouble had begun the day before admission, with pain and swelling at the angle of the jaw. Examination showed only swelling of both

⁴ This case is included in the article on the Cerebral Complications of Mumps Arch. Int. Med., June, 1919.

parotids. His temperature was 101.3°. He continued to have fever as late as April 13, reaching 104° on April 11. Blood culture on the day of admission showed a Gram-positive diplococcus. He made an uneventful recovery and was sent to duty April 21, 1919.

CASE IV.—O. B. M., Sgt., Co. II, 3d Tr. Bn., aged twenty-three years, white, was admitted to the hospital February 6, 1919, suffering from acute tonsillitis. His family history was negative. He had measles and whooping-cough in childhood and influenza in January, 1919. He gave no history of mumps. The tonsillitis rapidly subsided, but he was held for observation for dizziness, which had developed suddenly while he was exercising on a horizontal bar in July, 1918. On March 6 he complained of joint pains, and it was noticed that his left submaxillary gland was swollen and there was also a swelling at the angle of his jaw on the right side. He had no fever. On March 21 his temperature was elevated and his left knee was swollen and tender. The submaxillaries were still enlarged. His ankles and wrists later became involved. His temperature was as high as 104°. On March 24 he began to have marked swelling and tenderness of the left testicle, which gradually subsided. There was a slight recurrence of the arthritis later. He was sent to a general hospital May 2, 1919, for further convalescence. A blood count done March 26 showed 4,900,000 red blood cells and 12,000 leukocytes, with a differential count of 72 per cent. polymorphonuclear neutrophils, 19 per cent. small mononuclears, 8 per cent. large mononuclears and 1 per cent. transitionals. A blood culture taken on the same date showed a Gram-positive diplococcus. His Wassermann was negative. Morphologically and culturally this organism was just like the coccus isolated from the preceding cases.

CASE V.—S. J., Pvt., Prov. Gd. Co., aged twenty-three years, white, was admitted to the hospital April 3, 1919. His family history is unimportant. He had had measles, diphtheria and whooping-cough. He denied venereal infection. The day before admission he began to have pain and swelling at the angle of the jaw on both sides. His temperature was 99°, pulse 100 and respiration 24. Both parotids were swollen. Examination otherwise was negative. Blood culture yielded no growth. He continued to have fever, going as high as 103° on April 5. His temperature then fell for three days, reaching 104.1° on April 10, coincident with a severe orchitis on the right side. Following the orchitis the right inguinal glands gradually enlarged and became tender. These were at first discrete and rubbery, but an area of softening finally appeared in the center of the chain of glands. There was no urethral discharge at any time or any demonstrable lesion in the genital tract except the orchitis. The orchitis cleared up completely. He continued to have fever in the afternoon, usually between 99° and 100°. On May 20 the right inguinal glands were excised. Throughout the mass of glands there were areas of necrosis containing thick, greenish pus. Smears showed a few Gram-positive diplococci, which were grown in dex-

trose broth. One-fourth of a cubic centimeter of the broth culture was injected into the testicle of a rabbit. There was primary inflammation, which quickly subsided. On the eighth day the injected testicle began to swell and became about five times normal size. The swelling continued for four days. Cultures were made from a drop of fluid obtained by puncture of the swollen testicle, but no growth was obtained. The testicle gradually returned to normal size.

Major D. L. Harris, M.C., Chief of the Laboratory Service, makes the following report on the excised glands: "Examination of sections of this gland shows numerous foci of necrosis. Surrounding these areas there are large numbers of epithelioid cells and a few multinucleated giant cells. The cells have the peripheral arrangement commonly observed in tuberculosis. No tubercle bacilli could be found in the stained sections (alcohol fixation used), but the lesions resemble in all respects those found in tuberculosis."

Clinically, the condition did not suggest a tuberculous adenitis. It followed a severe orchitis directly, and there was no other demonstrable lesion in the area drained by this group of glands. We know that the mumps organism excites a mononuclear reaction, which is best shown perhaps in the pleocytosis of the spinal fluid in mumps meningitis when the cells are all mononuclears. A diplococcus was found in direct smear and the injection of the broth culture produced an orchitis in a rabbit. No tubercle bacilli could be found in sections. We believe this was a granulomatous lesion in the gland caused by the mumps organism.

Major Tasker Howard, M.C., Chief of the Medical Service, reports from this hospital three cases in which a meningo-encephalitis was the only manifestation of mumps. The spinal fluid from two of the patients showed a Gram-positive diplococcus on smear and culture identical with the organism described in this paper. A saline suspension of the culture from one spinal fluid was injected into the testicle of a rabbit. On the following day there was some swelling, which subsided quickly. Nine days later there was a marked orchitis. Smears from the testicle showed lymphocytes and Gram-positive diplococci, which were grown in culture.

SUMMARY. Five cases of mumps are reported in which a Gram-positive diplococcus was isolated from the spinal fluid, the blood and a lymph gland.

The injection of the organism into the testicle of a rabbit produced a severe orchitis in ten days.

These findings confirm the earlier reports of similar organisms from cases of mumps.

Mumps is probably caused by a Gram-positive diplococcus and not by a filterable virus.

I am indebted to Major Tasker Howard, M.C., Chief of the Medical Service, for the privilege of studying and reporting these cases, and to Private E. R. Brooks, M.D., U.S.A., of the laboratory, for making the cultures and the animal inoculations.

IS ESSENTIAL EPILEPSY A LIFE REACTION DISORDER?¹

BY L. PIERCE CLARK, M.D.,

NEW YORK CITY.

THE present, perhaps, may be considered a fitting moment and place to state, more or less briefly, some of the newer psychological observations of essential epilepsy, viewed largely as a life-reaction disease or syndrome occurring in particular types of individuals possessed of certain instinctive or inherent defects of character or emotional make-up. We shall discuss (1) the so-called epileptic character and its development; (2) the causes of the epileptic fit; (3) the nature and meaning of the fit itself; (4) the rational deductions in care and treatment of epilepsy drawn from such a viewpoint and study.

For the purposes of this paper, essential epilepsy is meant to embrace that type of the disorder which is exclusive of the so-called organic epilepsies and those suffering from definite physical lesions or disfunctions of the viscera which secondarily induce the disease, thus leaving an apparently sound and healthy individual having epileptic attacks of apparent idiopathic origin. A life-reaction disorder is meant to embrace that type of phenomenon which may be compared to a state of rage or anger as seen in bad-tempered individuals or excessive emotionalism as seen in the hysteric and the like.

From ancient times the essential epileptic has been considered a peculiar type of individual. The salient features of the so-called epileptic personality in its most exquisite and classic evolution are egocentricity, extreme supersensitiveness, marked emotional poverty and rigidity of ideation and mentation. For years this character type has been supposed to develop in direct proportion to the severity and frequency of epileptic seizures upon which it has been assumed to depend more or less directly. Careful analysis has, however, shown that while the most glaring character faults and mental deterioration may be seen in those epileptics with frequent and severe seizures, this is by no means the invariable rule, there being many defects of instincts and evidences of severe habit deterioration in epileptics with but mild seizures. Indeed, many epileptics may undergo increasing impairment in seizure frequency and severity independent of sedatives, and yet such individuals may show by life reactions as well as by psychological tests that the deterioration is progressive and marked. The reverse of this statement may also be shown. In consequence we have come to realize that while the severity and seizure frequency on the one

¹ Read before the American Psychopathologicpl Association, Atlantic City, June 18, 1919.

hand, and instinctive defects and mental deterioration on the other, may be to some degree coincident, they bear no essential causal relation. On the contrary both syndromes are the expressions of a deteriorating process not summated in fits or their congeners. For several years I have studied a large series of essential epileptics as to their primary mental endowment before fits occurred. It was found that in practically all there was nothing wanting in mental makeup not seen in the frank and veteran epileptic. The character faults varied, perhaps, in the amount and degree present in such potential states before seizures, but the character defects were sufficiently glaring to mark such individuals as pathological personalities portending a possible epilepsy in later life.

THE DETAILED DEVELOPMENT OF THE EPILEPTIC CHARACTER. Inasmuch as the life reactions of the epileptic character are the distinguishing factors of the makeup, we may sketch the defects of maladjustment at the several epochal levels of life stress. At birth the potential epileptic child frequently has periods of meaningless crying. This extra-irritability and sensitiveness is so pathological that it rarely fails of detection and record. For instance, one history states the child "was considered a nervous and irritable child from the day of birth." A second "fretted continually at the contact of rough clothing," while a third "was nervous and persisted in infantile demands long after weaning." A fourth "cried continuously the first three months," although nothing physically abnormal could be detected. One infant nearly went into spasms at the sound of an air-brake. Still another had to be rocked continuously and slept only during this care. The next important sequence in such a character is its non-pliability in being taught nursery ethics—that is, obedience and proper daily deportment in the home. These behavior defects are usually independent of purely intellectual and physical ones, and these infants sit up, creep, talk and walk at the usual ages. Indeed, in not a few the physical and the intellectual development seem accelerated and certainly are hyperactive. Extreme lability of mood is a frequent factor. One moment contented and the next irritable beyond power of appeasement is often noted. The consecutiveness of purpose in play and capacity to be amused is short, requiring the constant attention of the parent and a variety of interest appeal. Of one such epileptic it is stated that "he seems never to have developed out of his infantile ways; his rigid attitude of mind as a child is still in evidence in his adult life, and now he has fits added." Tantrum episodes even under the mildest discipline are most common in these difficult children. Their maladaptive defects are soon shown in their association with other children. They demand the play to be arranged to suit them; a game must be played a certain way; it must be continued or stopped as they direct. Their likes and dislikes are extreme. In the school

under an impartial discipline these potential epileptics show the most marked traits. The mood is inconstant, the interest and attention continually vary, and hence their more purely intellectual processes often show wide dissimilarities in evolution. Extremely brilliant in some subjects and quite ignorant in others is the general rule. Because of their extreme nervousness and inability to conform to school routine, many children fail physically and mentally and cannot take on the normal school training. Some are privately tutored; others are exempted from school discipline and routine except for short periods. Such scholars often appear pale and haggard, the pupils of the eyes are dilated, and they grow lethargic and sullen or sit day-dreaming and yawn, although not really sleepy. They grow intolerant of the school and often rebel at its confining and exacting demands. Thus in infancy and early childhood the instinctive defect of the ego fails of proper sublimation or extraversion; the adjustment to the social and physical environment is incomplete and unsatisfying, and, thrown back upon itself, in consequence there is a reinflation of self-importance and sensitiveness. Childhood, therefore, is a fruitful period for new and unbearable stresses, and sequential epileptic attacks often occur in one predisposed. The next stressful period is at puberty; here the dissolution of the oftentimes irksome home ties may release some from the galling exactions of home discipline, but most frequently, as in the departure for school, with its exactions in deportment, we find the puberty adjustment to work and social demands increasingly onerous. The potential epileptic is not willing to take on a proper attitude of apprenticeship. He has the innate instability of the constitutional inferior, but the good-natured indifference of the latter is not his attitude; his feelings are easily hurt, he has illy defined paranoid persecutions which cause him frequently to react with violence, insolence and hatred. He has attacks of rages, sullen moods and dispirited acquiescence in plans and undertakings. The lack of good fellowship renders him incapable of coöperative teamwork. The potential epileptic admires coöperation and the doing of big things in the abstract, but the requirements of interdependence and subordination to the main purpose galls and irritates him beyond endurance. He often develops fugues and tries a number of precarious jobs, often interspersed with excesses of self-indulgence. The potential epileptic during early adolescence begins already to present an odd mixture of primary defects of instincts plus a beginning deterioration of the higher capabilities of social adjustments known as habit deterioration. In part the latter is protective—that is, under the extreme stresses of this period he may ease off the stress by lowering or evading the exactions of precise behavior and deportment. Thus instead of presenting fits for a time he may take on various dissipations, alcohol, sexual excesses, wanderlust, gambling and licentious practices. The

explosive and impulsive character, the hatred and bitterness of the manner in which the acts are perpetrated, or underneath the seeming callous indifference and total lack of feeling with which the potential epileptic perpetrates these social delinquencies, is revealed the crudity and deep-rooted sadistic impulse of the epileptic character. With no real or intimate friends the potential epileptic holds himself aloof from the demands of the common sacrifice of self and the mutual dependence of social custom. He is a free lance, able and usually anxious to work his own will upon the world. If gifted with extraordinary intellectual endowments he may succeed for a time and make satisfactory progress toward his goal, but just short of it his egotism and ambition are often fired to new and impossible ends; when the whole scheme seems to him within final consummation some small trick of fortune adds the last burden of stress upon his mental and physical health and the individual breaks into frank manifestations of his disorder.

Freed in greater part from the trammels of social concern and demand, the intellectual efforts of the potential epileptic work with less stress than the normal, but in the final and more advanced consummation of his task the social customs of the family, friends and society itself fail to add their small but modifying influence as a directing force to the effort. In consequence new and unforeseen hindrances are added which in turn reduce the mental and physical invulnerability to the minimum, and at such defective periods some physical stress which at a more favorable time would be quite negligible appears as the precipitator of the frank disorder. Thus one learns to discount the common precipitating cause of the epileptic attack; such obvious studies are but surface ploughing of the etiological field in epilepsy. One is apt to think that inasmuch as epilepsy is essentially a disease of early life the great majority are unmarried because the state in itself bars marriage, but in the vast majority the reason is by no means so casual. It is really because the epileptic is rarely equipped in essential character makeup for marriage. Emotionally and sexually he rarely develops beyond the level of puberty and fails in capacity to attain adult love. Naturally this is to be expected in that the latter demands self-subordination and sacrifice, and above all a tenderness of feeling which is conspicuously lacking in the potential epileptic. In view of the foregoing it is evident that marriage increases demands socially as well as economically and makes not a few potentials break out in attacks. At the threshold of life the vast majority of potential epileptics break before or just at this period, which is the point of maximum stress. Almost all potential epileptics long before their disorder becomes at all acutely manifest, show increasing slowness and a diminished capacity for sustained employment. They show extra fatigue and diminished interest—a partly protective mechanism. A tenacious, consistent, all-around emotional

development in a life-work seems impossible in the vast majority. They work fairly well for a time, with plenty of emotional appeal, lavish praise and constant change—all essentially infantile traits of character—but in the end fail to do a thoroughly competent life-work.

THE NATURE AND MEANING OF THE CONVULSION. The muscular convulsion may be explained hypothetically in two ways, or a combination of the two explanations may be desirable. We know the convulsive part of the fit in its severer and cruder aspects is comparable to the impulsive movements of the infant. The impulsive fetal movements begin about the twelfth week of gestation, hence the brain cannot be involved *per se* in their genesis; further, it is known that brainless embryos possess impulsions. There is a short period just before birth in which the amniotic fluid and the uterine wall greatly inhibit the free play of these impulsive movements, but they begin again with renewed activity in the newly born and are slowly inhibited by voluntary control at the end of the nursing period. We do not know just how the impulsive movements are incited further than to surmise that, being of the first, simplest and ontogenetic type of activities of the developing organism, their incitor is from motor centers of the lower order. In these latter structures are stored up a certain quantity of potential energy which is transformed into actual energy by the blood and lymph stream. With the increasing tissue growth and tension engendered thereby this energy finds its outlet in the random movements of the fetus and the infant, and their exaggerated distorted presence is seen in the grand mal convulsion of epileptics. Time prevents us from outlining more in detail the essential distinguishing characteristics of the impulsive from the instinctive, reflex and conscious or ideational movements of the infant; this has been done most carefully by Preyer and later correlated into a recent study by Canestrini. Suffice it to say the newer studies on the meaning of the convulsive part of the epileptic fit make careful analysis of all the impulsive movements of the nursing doubly necessary. It will then be found desirable to note their exact relationship in reference to the psychosexual development and its defects as shown in the infantilism of the epileptic.

As might be expected the number of the impulsive movements is not great. They may be schematized as those of outstretching and bending the arms and legs in the newly born. The movements are sometimes so quick as to resemble the cloni of a fit. They may be slow, then fast and finally end in cloni. Even in healthy infants they may be so slow as to resemble the tetanoid spasm of a beginning focal seizure. Preyer speaks of the muscles involved in the impulsive acts as possessing such a slow, crawling movement that the acts present a striking resemblance to the extension and flexion of the limbs of animals waking from their winter sleep.

Such animals, like sleeping children, seen even in the first half of the second year make genuine fetal movements which often look as though they were directed against some invisible resistance. This all suggests many of the striking impressions one gains in observing the convulsions of epileptics. Convulsive motions in the infantile impulsions are, however, not generally so frequent in sleep as slow contractions. The latter are frequently attended by spreading and bending of the fingers which in turn become the rarer toward the end of the second year in all children of sound nervous systems. All these impulsive movements, in the hands especially, are asymmetrical in outline.

What are some of the depressors and incitors of these impulsive movements? Deep, profound and quiet sleep reduces them to the minimum. Satiation by food greatly curtails them. On the other hand a duplication of the intra-uterine state by the use of the warm bath encourages them. The movements are then usually slow and rather rhythmic and graceful. One may even see in them the beginning of an expression of pleasure. The face may join in the picture of contentment with slow asymmetric contortions, which semblance has an odd mixture of pleasure with more than a hint of displeasure. The greater part of the impulsions, however, are purposeless, senseless and asymmetric and are found over the entire body from the first day of birth. Writhing and twisting of the body are also frequent accompaniments to the movements of the face and extremities. Just as the infant sinks into deep sleep these impulsive movements slow down and the body usually comes to a state of rest in the fetal position. The fetal posture in the legs is kept up longer in advancing child life than that of the head and upper extremities. Many writers have called attention to the fact that no one could consciously duplicate these acts. Then, too, one is strikingly impressed that the infant and the epileptic alike are little fatigued by these most intense and persistent impulsions, which speaks strongly for the unconscious motivation in both their activities. Probably in both subjects the fund of reserve energy being so limited in scope is greater than that of the normal adult as ordinarily expressed in his daily activities. Biologically speaking we know that the essential vital energy of an individual is probably at its maximum at birth.

We are justified in considering the essential nucleus of the epileptic fit an infantile unconscious striving of displeasure-pleasure pursuit ending in the final goal of a return to infancy, attended by a loss of consciousness and a convulsion; that the convulsion is made up of and flows out of the general striving of the fetal and infantile tissues as expressed through the lower spinal centers in inducing simple and crude combinations of impulsive movements; that a study of the degree of development of unconscious infantile strivings in the emotional instincts, the desire for an infantile state

of omniscience, are paralleled by the kind and character of impulsive movements found in this infantile period of neuromuscular development. Therefore the two main settings in the epileptic fit, unconsciousness and convulsion, are psychical and physical correlates; lastly, that epilepsy in its essential pathogenesis is an error or arrest in this fundamental elaboration or development of the emotional life.

Having schematized the dynamic mechanism of the epileptic fit, we may note that the essential pathogenesis of the disorder as a whole is still to be attacked. Whether the latter rests upon an inheritance of certain psychic traits alone or whether there are certain somatic structural anomalies which do not permit proper psychosexual development into normal adult life one cannot say. I believe such studies, however, narrow the gap between such causes and their psychophysical expression in epilepsy; and finally, such observations must be of greatest aid in classifying the recoverable epileptics from the irrecoverable ones. It also points the way by which we may advance our therapeutics of the disease along the broadest biological lines of educational and moral treatment. In this connection one may note that MacCurdy has tentatively formulated the idea that the sudden loss of consciousness in epileptics liberates a muscular anarchy or "clotted mass of movement" of many different lower levels or physiologically controlled centers in the brain and spinal cord, and that the convulsive part of the fit is a released neuromuscular mechanism or series of mechanisms entirely secondary to the loss of consciousness, the main defect of the epileptic state. He holds the same fundamental postulate as to the psychological meaning of the epileptic fit as we have formulated it.

THE PSYCHOLOGICAL CAUSES OF THE LOSS OF CONSCIOUSNESS. Given the inherent defect of makeup just detailed, it is easy to comprehend how all forms of undue physical and mental stress may operate deleteriously upon the epileptic. The gradations of epileptic reactions vary from day-dreaming, lethargies, petulance, sullenness and outbursts of impatience and temper beyond the casual, until there succeeds a series of petit mal attacks or a severe grand mal, when the lowering skies in the epileptic's life are dispelled for a time until the stresses again accumulate to an explosive level. So long as normal consciousness is maintained the stress may work its evil consequence in ways well known to all. The epileptic reaction from its mildest to its severest manifestation is really a protection, for it obliterates reality and reduces the subject to the lowest level of organic response—that of a comatose state. Hence the fit is really a protective mechanism, psychologically considered at least. It withdraws or reduces the subject's attachment and adjustments to reality. It dispels an intolerable demand and the epileptic retreats to a state of harmony and peace. In the

retreat after incomplete attacks we frequently encounter unconscious strivings and conflicts that have baffled the subject. So exogenous causes, physical and mental in character, slight as they may seem to be, precipitate a conflict which springs the fit-gun, and a series of conflicts of different levels in the unconscious are exposed until after the severe grand mal attack the subject is reduced to the lowest level, comparable to earliest infantile life. When this hypothesis was enunciated a few years ago it was as yet uncorroborated by exact data, but since that time innumerable studies bearing out every contention of the mechanism have been deduced. Thus we find in the mild and transitory deliria of the automatic phase after petit mal attacks the subject may say or do certain things which may be pieced together and minutely analyzed. Like the mental content in manic states or drug and fever deliria these spontaneous productions have to do with the conflicts of every-day life. Then appear the successive deeper levels of emotional strivings and conflicts. For instance, at first the epileptic attempts to rid himself of an onerous task or unpleasant companions; sexual strivings are uncovered and in the deepest level he has made a retreat to the home, is in the cradle or the mother's arms, etc.

THERAPEUTIC DEDUCTIONS. Anyone following this therapeutic procedure should bear in mind that epilepsy from its very nature is a deteriorating disorder physically and mentally, and if it be allowed to progress it steadily lowers the capacity of the individual to make new and difficult adaptations. Hence any treatment which is based upon widening the plan of living is in itself bound to be very stressful. At first one cannot put this extra strain upon the epileptic without entailing more attacks than before. Frequently the plan of analysis given here must be undertaken for short periods only (days or weeks), and then the patient should be allowed to rest in his newly acquired position until he thoroughly accustoms himself to it, when more advanced work may be again undertaken. If the same content in the automatic state repeatedly returns, one must conclude that the special conflict about which the desire in the content groups itself is so basic that mere analysis will not set it free. Then a practical system for eliminating this defect must be instituted. Sooner or later one finds that simple analytical talks are the supplemental guides to more definite methods of training out the personality defect. The susceptibility to meet this reëducation will give a just estimate of the prognosis in the individual case. It has also been found that coincident with a gradual disappearance of epileptic reactions, as shown in the fits, *per se*, there must be a corresponding increase in capacity for work and other spontaneous living interests. Usually these clinical evidences of betterment are heralded by a shortening in the reaction time and a lessening of perseveration. The mere cessation of attacks, especially under sedatives, without corresponding improve-

ment in the psychological tests, is an indication that the underlying deteriorating disorder has not as yet been favorably modified and that the epilepsy may in course of time be expected to break out again after a temporary arrest.

In conclusion, one may say that a psychological study of the mental content in epileptics, both conscious and unconscious, demonstrates: (1) the depth of unconscious regression; (2) the special types of conflict which the epileptic has and the way he tries to solve them; (3) the specific type of primary defect in his endowment. Its therapeutic value in addition is (4) to furnish a specific point of analytical attack by simple explanatory talks; and (5) to show more definitely the type of special education which should be adopted for each individual patient.

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BLOOD TRANSFUSION.

BY J. R. LOSEE, M.D.,

PATHOLOGIST TO THE NEW YORK LYING-IN HOSPITAL.

Blood transfusion as it is practised today in the foremost hospitals is one of the greatest therapeutic advances in the last decade. The indirect methods which have been introduced are not only more practical procedures, but they also produce the desired clinical results. The technic of direct transfusion is an art which requires the skill of the best surgeons, and even in their hands it is not always successful, whereas the indirect methods can be performed by anyone who has a competent laboratory at hand and is familiar with venipuncture. To Dr. E. Lindeman¹ is due the credit of reviving and perfecting the syringe cannula method which was used by von Ziemssen² in 1892. Since Dr. Lindeman's introduction of the

¹ *Am. Jour. Dis. Children*, 1913, vi, 28.

² *München. med. Wchnschr.*, 1892, No. 19, p. 323.

if life can be prolonged for a few months or years, transfusion is well worth while.

Transfusion is one of the best remedies we have for pernicious anemia, for although it probably never cures this disease it may repeatedly initiate remissions in many of the chronic cases and these remissions often last much longer than the normal remissions. In my opinion it is advisable to transfuse patients suffering from both primary and secondary anemia earlier than has been the usual custom and not wait until the hemoglobin is below 30 or 40 per cent. and the red cells below 2,000,000. By so doing the patient will avoid for some time that severe grade of anemia which produces exhausting effects and extensive degeneration of the parenchymatous organs.

Transfusion is occasionally of some value as an additional therapeutic aid in typhoid fever, prolonged suppurative cases and certain medical conditions, associated with a marked or moderate grade of anemia in which some such agent is necessary to throw the balance in favor of the patient rather than the disease.

ISOHEMOLYSINS AND ISO-AGGLUTININS. Before there was any knowledge of iso-agglutinins or isohemolysins certain definite clinical reactions took place in the patient during or after transfusion which were characterized by severe symptoms and occasionally death. This phenomenon, which did not occur in all transfusions, was attributed to the introduction of air into the veins.

It has been shown by Ottenberg and Kaliski⁹ that these severe reactions are due either to isohemolysins or iso-agglutinins, or both in the blood serum of the donor and the recipient, and that by making careful preliminary blood examinations these accidents can be absolutely avoided. Moss and Ottenberg appear to be somewhat divided as to the occurrence of hemolysins in human blood. Moss¹⁰ says that isohemolysins are probably always preceded or accompanied by iso-agglutinins, both in health and disease, and cited but two instances in 100 examinations in which the isohemolysins occurred independently of iso-agglutinins. This result he attributed to faulty technic. Many workers have followed Moss's hypothesis, and in making the preliminary tests have examined blood only for iso-agglutinins.

Ottenberg and Kaliski¹¹ say that hemolysis of one human blood by another is a pathological phenomenon and has demonstrated it in a variety of diseases, while Moss¹² states that isohemolysins occur in about 25 per cent. of human beings. It is therefore quite apparent that both investigators differ as to the occurrence of hemolysins in human blood in health and disease. After the examination of many specimens of blood it has occurred to me that as long as the tests are confined to normal individuals or to those who have suffered from

⁹ Jour. Am. Med. Assn., 1913, lxi, 2138.

¹¹ Loc. cit.

¹⁰ Johns Hopkins Bull., 1910, xxi, 64.

¹² Loc. cit.

acute hemorrhage the group agglutination reactions of Moss are quite sufficient. When examining the blood of patients suffering from a chronic disease it is well to make the additional test for hemolysins, as these hemolysins may be developed in the course of that particular disease, and in some instances they may be auto-hemolysins.

Iso-agglutinins are inherited, occur in normal bloods and can be readily tested for by modern methods. Landsteiner¹³ and Shattuck,¹⁴ working independently, in 1901 discovered iso-agglutination of human red blood cells, and Landsteiner divided human beings into three groups according to the inter-agglutination reactions of their bloods. In 1907 Jansky¹⁵ proved that human beings fall into four groups, and this was later confirmed by Moss.¹⁶ Since then the technic of determining the group to which an individual belongs has been simplified by Brem,¹⁷ Sanford¹⁸ and Moss,¹⁹ and the determination can be made in a few minutes.

It has been suggested by some observers that individuals may change their groups after repeated transfusions, but it has been my experience that as long as the donor and recipient have been of the same group it is very unlikely that any change takes place. On the other hand if agglutinable cells are injected into a patient it is quite possible to assume that new agglutinins will be formed. In fact, Ottenberg, Kaliski and Friedman²⁰ have shown that dogs transfused with agglutinable cells will apparently develop iso-agglutinins *de novo*, but this will not occur when the injected cells are not agglutinable.

Ottenberg and Kaliski²¹ have demonstrated by blood smears during and after transfusion, in which the donor's cells were agglutinated by the recipient's serum, that phagocytosis of red blood cells occurred, but in cases in which the serum of the donor was agglutinable for the cells of the patient no phagocytosis was observed. This is due to the dilution of the agglutinins in the serum of the donor by the serum of the recipient and has led to the practice of using Group IV as the universal donor, inasmuch as the serum of Group IV agglutinates the cells of Groups I, II and III, and Group I as the universal recipient, as its serum does not agglutinate any corpuscles. These facts, together with the occasional occurrence of a serum weak in agglutinins, are responsible for the few reactions which occur when no preliminary tests are made.

¹³ Centralbl. f. Bacteriol, 1900, xxviii, 357; Wein. klin. Wehnschr., 1901, xiv, 1132.

¹⁴ Jour. Path. and Bacteriol., 1900, vi, 303.

¹⁵ Abst. Jahresb. u. d. Leistung u. Fortschr. a. d. Geb. d. Neurol. u. Psychiat., 1907, xi, 1092.

¹⁶ Johns Hopkins Bulletin, 1910, xxi, 64.

¹⁷ Jour. Am. Med. Assn., 1916, lxxvii, 190.

¹⁸ Ibid. p. 808.

²⁰ Jour. Med. Research, 1913, xxviii, 141.

²¹ Jour. Am. Med. Assn., 1913, lxi, 2138.

¹⁹ Ibid., 1917, lxxviii, 1905,

DONORS. As far as possible donors should be strong, healthy, muscular individuals without a nervous or timid temperament, otherwise the operation may be terminated earlier than is desired on account of an attack of syncope. Wassermann tests and a physical examination are made on all donors before each transfusion regardless of the fact that they have been examined on previous occasions. Syphilis has been transmitted on more than one occasion in this way and in the examination of 150 donors I have obtained six strongly positive reactions. Even after explaining the seriousness of transmitting this disease, donors have denied a history of the infection in every instance.

It has been the practice of the laboratory during the past three years to have on file a number of donors in each group, and when the emergency arises the patient is grouped and a suitable donor is reached by telephone or telegraph. On his arrival he is again tested for iso-agglutinins and isohemolysins and a Wassermann is made in order to be doubly sure that he is the most suitable candidate. Agglutination tests are made according to the latest methods of Moss,²² and if there is time this is confirmed by Brem's²³ method. In using the group method one is less liable to overlook a serum weak in agglutinins, as this mistake occasionally occurs when the serum and cells of the patient are tested against the serum and cells of the donor according to the method of Lee.²⁴ Brem²⁵ recommends the use of Group II serum and cells as a standard, but it is of greater advantage to make the test with Group III serum, as 40 per cent. of individuals are in Group II and only 7 per cent. in Group III. Therefore, cross-agglutination will occur almost six times as often in testing unknown bloods. Examination is also made for hemolysins if it is thought necessary after a consideration of the patient's history. When the group system was first introduced hemolysin reactions were always made as a check, but this was soon found unnecessary in patients who were acutely ill from hemorrhage or sepsis. With the Moss method there is no emergency so great but that the operator can be reasonably assured that he is transfusing patients with compatible bloods. Very often in the hospital service patients are admitted in a serious condition after hemorrhage and prompt action must be taken. The patient, the friends and the hospital porters are grouped while the necessary preparations are being made for the operation. As far as possible only individuals of the same group are transfused, and when this cannot be done a Group IV donor is selected.

The amount of blood taken from the donor depends on the weight and condition of the patient, the weight of the donor and the indication for which the operation is performed. Inasmuch as the

²² Jour. Am. Med. Assn., 1917, lxviii, 1905.

²³ Ibid., 1916, lxvii, 190.

²⁴ British Med. Jour., 1917, ii, 682.

²⁵ Jour. Am. Med. Assn., 1916, lxvii, 190.

blood in the human organism is about one-nineteenth of the body weight, and a man weighing 170 to 190 pounds would have from 9 to 10 pounds of blood, one-fifth to one-fourth of this amount could be transfused without any unfortunate result. However, it is always well to watch the donor for such symptoms as yawning, sweating and a lowering or elevation of the pulse-rate, as under such conditions it is advisable to stop. Very occasionally they go into collapse, from which they recover in a short time under appropriate treatment. This is not a pleasant feature and can always be avoided by carefully observing the donor when the amount transused approaches 1000 c.c.

At the present time professional donors are repeatedly submitting themselves for transfusion when they are not physically fit. This can be readily determined by taking the percentage of hemoglobin and by bleeding them into a test-tube and estimating the relative volume of solid and fluid constituents of the blood. The blood of one who has been repeatedly bled and is suffering from secondary anemia always shows a much larger proportion of serum than cells; this type would certainly not be the most beneficial to the patient. Some donors are used as often as every six weeks, but an interval of from three to four months is more desirable in most individuals.

RECIPIENT. Unlike the donor we have no choice in selecting the recipient, but if time permits they are placed on a Karrel diet (900 c.c. of milk) for twenty-four to forty-eight hours before the operation, so that the transfused blood is less liable to overburden the heart. A mild cathartic or low enema is also given depending upon the physical condition of the patient, and occasionally a hypodermic of morphin one-half hour before the operation relieves the nervous excitement and slight pain associated at times with the procedure.

METHODS. At the present time physicians interested in transfusion differ widely in their opinions as to the relative value of modified and unmodified blood. The citrate method has gained its popularity on account of the facility with which it is performed, but there is no reason to believe that it is as beneficial to the patient as the unmodified blood which is not subjected to a chemical change and which is out of the body such a short time. It is indeed quite true that citrated blood is entirely efficient in patients suffering from acute hemorrhage when volume only is needed, but with patients who have had a severe anemia for some time and are in poor physical condition the method which will accomplish the best results with the least possible tax on the already poorly functioning organs of the patient is the one to select.

The syringe cannula method of Lindeman,²⁶ where the operator,

²⁶ Am. Jour. Dis. Children, 1913, vi, 28.

assistant and nurse work together perfectly, is the nearest approach to a direct transfusion that can be obtained, and therefore the advantages of both the direct and indirect methods are combined. On the other hand with poor teamwork it can be made an absolute failure; thus it is very important to have the same assistants at every transfusion in order to be assured of the highest type of efficiency.

Inasmuch as the citrate method can be performed by one individual it is adaptable to emergency cases and to cases outside of an institution. Drinker and Brittingham²⁷ have reported several transfusions using different methods and make the impartial statement that it would seem that both the syringe cannula and the paraffin tube methods offer fewer reactions than the citrate. Clowes²⁸ has called attention to the similarity of sodium chloride and sodium citrate in their general effect on protoplasm. The difference between the salts is a function of the anion and the citrate is infinitely more toxic than the chloride no matter what the test material. The choice of the method depends upon the means at hand, and, whenever possible, the syringe cannula technic is to be preferred because it is the best method we have of injecting the same kind of blood that is already circulating in the vessels of the recipient.

REPORT OF CASES. Since the introduction of indirect transfusion I have performed the operation 100 times on 79 cases, 81 by the syringe cannula technic and 19 in which sodium citrate was used as the anticoagulant. The cases of acute hemorrhage and sepsis occurred in the obstetrical service of the Lying-in Hospital and the chronic cases were transfused at home.

CONDITIONS FOR WHICH TRANSFUSION HAS BEEN PERFORMED.

Disease.	No. of patients.	No. of transfusions.	Died.	Recovered	Improved.	Not improved.
Hemorrhage	28	30	6	22		
Hemorrhage & pelvic sepsis	28	28	..	28		
Sepsis (general peritonitis, bacteremia and septic thrombophlebitis)	7	12	6	1		
Secondary anemia	8	10	..	..	6	2
Pernicious anemia	3	14	..	..	3	
Banti's disease	1	2	..	..	1	
Toxemia of pregnancy . . .	4	4	2	2		

The fourteen deaths in this series, with the exception of one case which will be explained, were all due to the disease from which they were suffering and were not a result of the transfusion.

²⁷ Arch. Int. Med., 1919, xxiii, 133.

²⁸ Jour. Phys. Chem., 1916, xx, 407.

Under "Indications" I have already discussed the results obtained in the majority of these conditions, but I desire to mention one case in more detail in order to demonstrate the marked temporary improvement that does occur quite occasionally in patients suffering from chronic anemia. This patient has pernicious anemia and has been transfused nine times. Before each transfusion the physical condition was desperate, but after the injection of 1000 c.c. of blood the annoying noise in the head disappeared, the cough and subcutaneous edema cleared up and the appetite returned. Whereas before the transfusion the outlook was that of a fatal termination in a few days or weeks, while afterward this patient took a new lease on life and became interested in affairs even to the extent of returning to business. This result is due to the increase in the volume of blood and to the stimulation of the hematopoietic organs, but ultimately the hematopoietic organs do not respond to this stimulation and the patient depends entirely upon the mechanical action of the blood introduced which is of short duration. Occasionally it is necessary to transfuse cases at weekly intervals in order to get the blood up to a point where it will remain at a constant level for some time.

REACTIONS. A severe reaction with all the classical symptoms of hemolysis occurred early in my experience after an emergency transfusion for postpartum hemorrhage, but before which no examination for hemolysins and agglutinins were made. In no other case has there been any reaction due to hemolysis or agglutination, and I attribute this to the care with which the donors have been selected. I am surprised, after reading the protocols of some of the later articles in which serious reactions are described, for these have undoubtedly been due to careless laboratory work and in most instances it is very probable that the tests have not been made or supervised by the same individual that did the transfusion. Contrary to the conclusion of Sydenstricker, Mason and Rivers,²⁹ repeated transfusions in pernicious anemia can be done without danger to the patient if due care and patience are taken in selecting the donor.

Mild reactions characterized by a slight chill, rise of temperature and vomiting have occurred in a certain percentage of the series, but these were all transitory and passed off in twelve to twenty-four hours. The more perfect the technic of the syringe cannula method the less often will these so-called mild reactions occur. The careful and thorough washing of the syringes, the filling and emptying of the syringes and the length of time the blood is outside the body are small details which, if not carried out, may give rise to these reactions and establish the platelet and the anaphylotoxin hypotheses.

²⁹ Jour. Am. Med. Assn., 1917. lxviii. 1677.

CHANGES IN THE BLOOD FOLLOWING TRANSFUSION. The relation between the amount of blood transfused and the blood count afterward is a variable feature and is undoubtedly connected in some way with the condition of the individual patient at the time the transfusion is performed. A review of the protocols in an article by Huck³⁰ shows that in pernicious anemia the increase in red blood cells varied from 404,000 after a transfusion of 1250 c.c. to 1,784,000 after 750 c.c. in twenty-four hours. Huck's results after a series of observations is that, "in general, following the injection of blood there was an immediate increase in the red cell count. In some cases the initial increase continued for several hours, usually falling so that at the end of twenty-four hours the count had fallen to approximately where it was before transfusion. In other cases, however, there was a marked increase at the end of twenty-four hours. In several instances after the injection of blood the count fell for a few hours and then rose slightly. The hemoglobin in most cases showed a uniform rise following transfusion, usually reaching its maximum at the end of twenty-four hours. In practically every case there was some increase in the number of leukocytes." He concludes by saying that "the introduction of blood raises the count, that the effect is essentially a biological one involving the redistribution of blood in the body and its exact nature is not at present understood."

CONCLUSIONS. 1. The indirect method of transfusion, on account of its universal adoption, has saved the lives of many patients suffering from acute hemorrhage.

2. Patients suffering from primary and secondary anemia should be transfused early in the disease in order to obtain the best results.

3. Certain laboratory examinations are absolutely essential to the success of transfusion.

4. The syringe cannula method transfers blood from the donor to the recipient with the least possible physical or chemical change, and is therefore associated with fewer reactions.

5. No definite relation can be established between the amount of blood transfused and the blood count afterward.

I wish to thank Dr. E. D. Truesdell who has been associated with me in carrying on the teamwork necessary for the success of the Syringe Cannula Method.

³⁰ Johns Hopkins Bulletin, 1919, xxx, 63.

VACCINATION BY SUBCUTANEOUS INJECTION.

BY MAJOR J. R. GOODALL, C.A.M.C., O.B.E., B.A., M.D., C.M.,
D.Sc. (MCGILL UNIV.), F.A.S.G.

ASSISTANT PROFESSOR OF GYNECOLOGY, MCGILL UNIVERSITY, MONTREAL.

IN the spring of 1915, while attached to the Canadian Mounted Rifles as medical officer, I frequently discussed with Dr. George Hume, of Sherbrooke, the question of vaccination of troops by subcutaneous injection. He had done a few cases in this way, and before using this method upon the men of my unit I had it tried upon myself by Dr. Hume. I had been vaccinated ten times previously without success. Within three days my arm was sore and I went through all the general symptoms of successful vaccination.

Since then I have vaccinated hypodermically approximately 6000 men and quite a number of officers' children.

METHOD OF PREPARING VACCINE. It being impossible to procure vaccine in bulk, vaccine put up in the small capillary glass tubes was used in the majority of cases.

These vaccine tubes were first placed in methylated spirits for a few minutes, then withdrawn singly by surgically clean or gloved hands, the excess alcohol wiped off with sterile absorbent cotton, the ends broken off and lastly the sterile rubber bulb fixed to one end of the tube to blow out the vaccine into a sterile beaker. The vaccine generally shoots out of the tube into the beaker in the form of a small cylinder.

When the vaccine available was in small wax tubes the extreme end was first punctured with a sterile needle and the vaccine squeezed out by compressing the container.

From one-half to three-quarters of a tube of vaccine was used per individual. Sufficient sterile water was then added to the vaccine to make each injection equal to 1 c.c.

In private practice, or when one or two only are to be vaccinated, the vaccine may be prepared as an ordinary hypodermic injection, using vaccine instead of a drug.

Patients can be vaccinated with great rapidity. After preparation of the vaccine, four medical officers vaccinated 1100 in two and one-half hours by using 20 c.c. record syringes and injecting 1 c.c. into twenty successive men, changing the needle after each injection.

TECHNIC OF INJECTION. The arm was sterilized with iodine and the vaccine injected diagonally with a fine hypodermic needle and syringe into the subcutaneous tissues.

In a few cases, by mistake, the vaccine was injected intracutaneously.

Everything should be done with surgical cleanliness.

AFTER-EFFECTS OF INJECTION. The local reaction sets in usually between two and four days, but in a few cases the reaction is considerably delayed; and in one colonel's family three children were vaccinated and reaction did not appear until twelve, thirteen and fifteen days respectively.

The local reaction is much like that following antityphoid inoculation and just as variable in intensity. About 8 per cent. proved ineffective, showing but slight local reaction, not more than perhaps could have been accounted for by the iodine applied to the skin; in 70 per cent. (approximate only) there was a reaction similar to the usual reaction after antityphoid inoculation, *i. e.*, local swelling, heat, tenderness, slight pain and redness.

In a small percentage of cases the reaction was marked, causing swelling and edema of the elbow and, in a few cases, edema involving the whole arm and hand.

In every one of the 6000 cases vaccinated hypodermically by myself or under my supervision (for all of whom I myself prepared the vaccine for injection) the local condition subsided without any signs other than those of excessive local reaction.

After the seventh or tenth day the local swelling and induration subsided, leaving a hard nodule in the subcutaneous tissues, usually ill-defined at first, becoming later well-circumscribed and lasting for about one month. This is quite painless after the first acute reaction. The process differs in no respect from that of an antityphoid reaction, except that the onset is slower and the reaction spreads itself over several days.

The general symptoms vary in intensity and do not differ from those of ordinary vaccination.

INFECTION. In the 6000 cases quoted there was not one case of infection. This can be stated without question of doubt. The men were all soldiers who came directly under me and my medical officers for observation and for sick parade. They were all seen several times afterward, and in about 50 per cent. of the cases the vaccination was done at the same time or between the regular antityphoid inoculations. I saw one case of infection in another brigade; this was brought to my attention, and on close questioning it was found that there had been faulty technic. There was a punched-out ulcer about the size of a ten-cent piece, exposing the fascia. The ulcer healed without untoward result.

None of the 6000 required dressings, and the men were not exempted from anything but physical training and rifle drill.

A number were given light duty and a very small percentage were excused duty for a few days, owing to excessive local or general reaction. There were no hospital admissions.

In a few cases (about 10 altogether) the vaccine was injected intradermically, and about four or five days later there developed

the typical vesicular and pustular stages of ordinary vaccination, quite uncomplicated.

ADVANTAGES. 1. This is a clean surgical operation. If untoward results develop they are due to faulty technic.

2. There is no open wound and therefore dressings are not required.

3. Dangers of secondary infection are practically eliminated.

4. The percentage of positive reactions is very high.

5. In only a very small percentage of cases the local and general symptoms caused complete incapacity.

6. It is painless as compared with scarification.

7. Children undergo the hypodermic vaccination without any difficulty, owing to the rapidity with which the injection is carried out.

LABORATORY STUDIES IN INFLUENZA AT CAMP TRAVIS, TEXAS.

BY PHILIP B. MATZ, CAPTAIN, M.C., U.S.A.,

CHIEF OF LABORATORY SERVICE, BASE HOSPITAL.

WHEN the recent epidemic of influenza first appeared at Camp Travis it was thought advisable to ascertain what organisms were found most constantly in the nasopharyngeal and pulmonary secretions and exudates. Accordingly, cultures were made on defibrinated blood-agar plates of a selected number of patients who were stricken with the disease. In all, 868 cultures were studied and the bacteria isolated are given in the table below.

TABLE I.—NASOPHARYNGEAL CULTURES ON DEFIBRINATED BLOOD-
AGAR PLATES.

<i>Bacillus influenzae</i>	344 times
<i>Streptococcus</i>	108 "
<i>Pneumococcus</i>	83 "
<i>Micrococcus catarrhalis</i>	52 "
<i>Staphylococcus</i>	43 "
<i>Bacillus hofmann</i>	40 "
<i>Streptococcus hemolyticus</i>	22 "
<i>Bacillus friedländer</i>	22 "

The table shows that the Pfeiffer bacillus was found 344 times out of a total of 868 cases, in other words, the organism was isolated from the throats of 39 per cent. of the patients.

BRONCHOPNEUMONIA. The epidemic at Camp Travis was accompanied by a large percentage of bronchopneumonia. This complication was brought about by:

with the findings at postmortem, when acute parenchymatous changes were invariably found in the kidneys.

BLOOD EXAMINATIONS. The blood picture of the average case of influenza showed a slight leukopenia, with a relative increase of the small mononuclear cells. Just as soon as bronchopneumonia developed an increase of the polymorphonuclears in the differential counts and a slight increase in the total leukocyte counts were noted. Tables IV and V illustrate the blood findings.

TABLE IV.—DIFFERENTIAL LEUKOCYTE COUNTS, 222 CASES.

Per cent.	1-5	5-10	10-15	15-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Polynuclear	..	..	..	..	..	..	3	33	60	76	50
Small mononuclear	..	..	35	38	81	45	21	2			
Large mononuclear	123	19	1								
Transitional	96	2									
Eosinophiles	29	2									
Basophiles	12										

TABLE V.—TOTAL LEUKOCYTE COUNTS, 1084 CASES.

No. of leukocytes per cubic millimeter.	2000 to 3000	3000 to 4000	4000 to 5000	5000 to 6000	6000 to 7000	7000 to 10,000	Over 10,000
Times	32	73	133	163	173	215	295

BLOOD CHEMISTRY IN BRONCHOPNEUMONIA. The results of the chemical examination of the blood in 3 cases of bronchopneumonia are shown in Tables VI, VII and VIII. These cases (J. N., S. K., and J. K.), showed signs of acidosis and were being treated with dextrose solution intravenously. Case J. N. died. Cases S. K. and J. K. recovered. It will be noted in going over these tables that there was a marked retention of urea nitrogen and uric acid, especially while the patients were in acidosis, and that these blood constituents were reduced as soon as they began to improve. Case S. K. showed a marked increase of creatinin at a time when he was expected to die. His condition gradually improved and there was a corresponding decrease in the creatinin. The other 2 cases showed no increase in the creatinin at any time.

TABLE VI.—CASE J. N. (DIED).

	Dec. 8, 1918.	Dec. 11, 1918.
Dextrose: per cent.	0.48	0.16
Creatinin: mg. in 100 c.c. of blood	1.85	2.20
Urea nitrogen: mg. in 100 c.c. of blood	28.50	99.00
Urea: mg. in 100 c.c. of blood	60.95	211.86
Uric acid: mg. in 100 c.c. of blood	6.00	8.80
Chlorides: per cent.	0.43	0.47

TABLE VII.—CASE S. K.

	Dec. 1.	Dec. 3.	Dec. 4.	Dec. 5.	Dec. 7.	Dec. 8.	Dec. 9.	Dec. 13.
Chlorides: per cent.	0.44	0.48	0.51	0.52	0.52	0.51	0.47	0.570
Dextrose: per cent.	0.13	0.15	0.14	0.15	0.13	0.11	0.156	0.212
Creatinin: mg. in 100 c.c. of blood	1.00	2.50	2.20	4.00	5.10	5.00	2.70	1.50
Urea nitrogen: mg. in 100 c.c. of blood	20.75	32.25	83.50	114.00	148.00	85.00	61.00	36.000
Urea: mg. in 100 c.c. of blood	44.40	69.01	179.69	243.90	313.10	181.90	134.54	77.000
Uric acid: mg. in 100 c.c. of blood	6.40	7.30	10.00	10.40	11.80	9.60	6.70	5.200

TABLE VIII.—CASE J. K.

	Nov. 4.	Nov. 6.	Nov. 7.	Nov. 8.	Nov. 9.	Nov. 12.
Dextrose: per cent. . . .	0.12	0.10	0.12	0.10	0.12	0.11
Creatinin: mg. in 100 c.c. of blood	2.85	2.14	1.85	1.05	1.10	1.00
Urea nitrogen: mg. in 100 c.c. of blood	26.50	25.00	20.25	17.50	15.30	12.00
Urea: mg. in 100 c.c. of blood	55.71	53.50	43.33	37.45	32.70	25.70
Uric acid: mg. in 100 c.c. of blood	4.30	..	3.05	2.25	1.93	1.21
Chlorides: per cent. . . .	0.56	0.51	0.53	0.52	0.50	0.51

It is our opinion that the marked increase of the blood constituents referred to is due to protein injury, disintegration and autolysis accompanying excessive lung inflammation.

Table IX illustrates cases of pneumonia without any kidney involvement showing a distinct increase of urea nitrogen.

TABLE IX.

Name.	Lung involvement.	Albumin.	Casts.	Urea nitrogen, grams per 100 c.c.
Clausen	Both bases	Negative	Negative	27.25
Werhane	Both bases	Negative	Negative	44.10
Nichols	Left lobe	Negative	Negative	28.50
Fitch	Right base	Negative	Negative	23.70
Lanier	Extensive	Negative	Negative	34.10
Cannon	Left base	Negative	Negative	47.10
Baum	Right base	Negative	Negative	19.50
Alexander	Left base	Negative	Negative	19.50
Burke	Left base	Negative	Negative	19.00

Table X illustrates cases of pneumonia with kidney involvement showing retention of urea nitrogen.

TABLE X.

Name.	Lung involvement.	Albumin.	Casts.	Urea nitrogen, grams per 100 c.c.
Viertel	Both bases	Positive	Granular	21.30
Peters	Both bases	Positive	Negative	27.75
McDonald	Right base	Positive	Granular	16.30
Powlouski	Left lung	Positive	{ Granular and hyaline	41.10
Notzelman	Left lung	Positive	Granular	29.50
Helmbrecht	Right base	Positive	Negative	16.20
Florez	Both bases	Positive	Granular	32.00
Donnelly	Left lung	Positive	{ Granular and hyaline	53.00
Brown	Left base	Positive	Granular	31.20
Brememour	Left base	Positive	{ Granular and hyaline	26.00

In comparing Tables IX and X the conclusion of the writer is that the retention of urea nitrogen is due principally to protein

disintegration and autolysis associated with the pneumonic process, and that kidney involvement of a transient nature complicating pneumonia has no additional effect on the urea nitrogen content of the blood.

ACIDOSIS. Many of the cases of influenza pneumonia showed evidence of acidosis. This condition was demonstrated by a reduced combining power of the blood plasma for carbon dioxide. In these cases intravenous injections of 10 per cent. to 25 per cent. dextrose solution produced excellent results by acting as a food, producing diuresis and by helping to rid the tissues of the accumulated carbon dioxide. Table XI illustrates the figures obtained in cases of influenza pneumonia with the Van Slyke apparatus.

TABLE XI.

Name.	Lung involvement.	Kidneys.	CO ₂ combining power blood plasma, per cent.
Viertel	Both bases	Nephritis	46
McDonald	Right base	Nephritis	54
Fitch	Right base	Normal	51
Notzelman	Left lung	Nephritis	44
Helmbrecht	Right base	Nephritis	63
Florez	Both bases	Nephritis	45
Brown	Left base	Nephritis	47
Hokanson	Right base	Nephritis	48

PLEURISY AND EMPYEMA. It is striking that out of over 2000 bronchopneumonias there were, all told, but 49 cases of pleurisy or empyema. Table XII shows that 25 of the fluids gave positive smears or cultures. Those that were positive showed the pneumococcus present 16 times.

TABLE XII.

Pneumococcus unclassified	11 cases
Pneumococcus and streptococcus	1 "
Pneumococcus and influenza bacillus	4 "
Influenza bacillus	1 "
Pneumococcus, Type IV	2 "
Pneumococcus, Type I and streptococcus	1 "
Pneumococcus, B. influenzae, B. friedländer	1 "
Friedländer bacillus	1 "
Streptococcus hemolyticus	1 "
Streptococcus unclassified	2 "
Total	25 "
Cases with negative cultures	24 "
Total	49 "

The chemical examination of the blood was done in a number of empyema cases and the findings are seen in Table XIII. Most of them show an increase of the urea nitrogen content of the blood.

TABLE XIII.

Case.	Mgm. per 100 c.c. of blood.				Per cent.	
	Creatinin.	Urea.	Urea nitrogen.	Uric acid.	Chlorides.	Sugar.
H. H.	1.10	31.56	14.75	..	0.64	0.14
J. M. C. . . .	2.00	28.89	13.50	1.40	0.66	
S. M.	2.70	36.97	17.25	4.10	0.65	0.08
W. B.	1.25	41.59	18.50	1.60	0.69	0.13
J. M.	1.26	29.42	13.75	1.50	0.65	0.10
E. W.	1.53	32.63	15.25	1.50	0.70	0.12
T. B.	1.75	52.96	24.75	1.25	0.59	0.13
M. M.	1.85	27.82	13.00	3.25	0.68	0.12
W. H. B. . . .	1.10	45.15	21.10	1.50	0.52	0.13
H. T.	0.70	23.54	11.00	0.90	0.51	0.10
S. Z.	1.85	30.96	14.00	1.75	0.56	0.11
W. J.	1.20	32.74	15.30	1.50	0.51	0.09
H. B.	1.00	40.60	19.00	1.42	0.52	0.10
D. C.	1.10	28.89	13.50	5.10	0.66	0.02
T. T.	1.70	30.16	14.00	0.42	0.55	0.08
M. M.	1.85	27.83	13.00	3.25	0.68	0.12

MENINGITIS. The other complication of postinfluenza bronchopneumonia was meningitis. There were 16 cases in all. The pneumococcus was the organism isolated both by smear and culture in every case. The typings of the pneumococci recovered are given in Table XIV.

TABLE XIV.

Pneumococcus unclassified	3 cases
Type I and IIa	2 "
Type II	3 "
Type IIa	1 "
Type IIa and III	1 "
Type IV	6 "
Total	16 cases

GROSS AND MICROSCOPIC AUTOPSY FINDINGS OF POSTINFLUENZA BRONCHOPNEUMONIA. During the epidemic 26 autopsies were performed at this base hospital. A very careful study of the heart, lungs, liver, spleen, and kidneys was made. Following is a summary of the gross and microscopic findings on cases of postinfluenza bronchopneumonia:

Heart. In most of the cases the pericardial sac contained a straw-colored or a greenish-yellow fluid in excess of normal. In a small number of cases there were pleuropericardial adhesions. The heart as a whole was not markedly enlarged. The right auricle and right ventricle in nearly every case showed varying degrees of dilatation, and the left ventricle was almost constantly hypertrophied. The musculature of the left ventricle was generally of good color and tone. In a few cases vegetation or a sclerotic condition involved the mitral valve, and a few cases showed incompetency of the pulmonic semilunar valves and the tricuspid valves.

Pleura. With but one exception pleural adhesions, fresh in character and easily separated, were present, and these were more con-

stantly on the right side than the left, in the apical region. In some cases the surface of the lungs was covered with a greenish-yellow, friable exudate of a "butter-like" appearance, at times attaining a thickness of one-half inch.

Left Lung. Usually both lobes were the sites of patchy areas of consolidation. This condition was more pronounced in the lower lobe than in the upper. Pulmonary edema existed throughout the lobes not affected by consolidation. No fibrinous plugs could be pressed from the incised bronchi. On section, all stages of consolidation were noted.

Right Lung. Without exception the lower lobe of the right lung contained in some part of it if not in its entirety, consolidation so marked that it could not be differentiated from lobar pneumonia. Nearly every case showed some patchy area of consolidation in the middle and upper lobes as well. In a small number of cases the middle lobes were free from such involvement.

Liver. This organ was constantly enlarged, its surface smooth and of a "boiled liver" appearance. The capsule was not abnormally adherent. The organ cut with firm resistance, and blood exuded from the fresh surfaces. In some instances there was a greenish cast to the cut surface, suggesting biliary stasis. The gall-bladder was invariably distended with bile of varying degrees of viscosity.

Spleen. This organ was invariably larger than normal and markedly congested. In a limited number of cases the congestion was so marked that the spleen resembled a large mass of clotted blood.

Kidneys. Most cases found the kidneys to be enlarged and on section showed marked congestion and prominent outstanding of the Malpighian pyramids with widening of the cortex. In one case the left kidney was about one-half normal size, but it, like the others, presented the characteristics of an acute parenchymatous inflammation. As a rule the capsule of the kidney could be easily removed, but in a few instances it was abnormally adherent and the microscopic picture of these organs was that of a chronic interstitial change.

MICROSCOPIC FINDINGS. *Lungs.* The lungs showed an infiltration about the terminal bronchioles of mononuclear cells. The alveolar spaces in the immediate vicinity were filled with an exudate of epithelial cells, mononuclear cells, red cells and fluid. Some cases showed this exudate in various stages of its formation and dissolution. One could note in cases in which consolidation was massive, that the lesion was one of confluent pneumonia, as neighboring areas showed different stages of hepatization. At times one saw a thinning and rupture of the alveolar walls adjacent to these areas of consolidation.

Liver. The vascular structure of the liver showed marked engorgement, with almost invariable extravasation of blood around the central veins of the lobules. The liver cells were swollen and cloudy and

in many instances were larger than normal, making the hepatic cell chains stand out prominently in the liver lobules. The sinusoidal spaces were larger than normal. No areas of focal necrosis were noted.

Spleen. Throughout the sections studied there was a condition of cloudy swelling of the parenchymatous structure. The engorgement was pronounced.

Kidneys. The epithelia of the Malpighian tufts and those lining the uriniferous tubules were invariably larger than normal and of a hazy appearance, with nuclei staining weakly and desquamated. Some of the lumina of the tubules were completely occluded by either the swelling or desquamation of the lining epithelia. Some of the desquamated cells had undergone disintegration. No exudate nor adhesions were noted in the capsule of Bowman. The blood-vessels were very much engorged and red cells were found in the Malpighian tufts and between the tubules. The organs from which the capsule stripped with difficulty showed an increase in the interstitial element, indicative of an inflammatory condition of long standing.

SUMMARY. The epidemic of influenza at Camp Travis was characterized by the presence of the *Bacillus* of Pfeiffer in 39 per cent. out of a total of 868 throat cultures examined.

Blood cultures in the influenza cases were all negative.

Blood cultures in the complicating bronchopneumonias gave 11 per cent. positives. The organism recovered was the pneumococcus.

The blood picture of the average case of influenza showed a slight leukopenia, with a relative increase of the small mononuclears. When the bronchopneumonia developed there followed a slight increase in the total leukocyte count and an increase of the polymorphonuclears.

Chemical examination of the blood showed a retention of urea nitrogen in the pneumonias having no kidney involvement. The retention of urea nitrogen in cases having a transient nephritis was no greater. It is our opinion that this retention in the bronchopneumonia under discussion was due to protein injury and disintegration associated with extensive lung inflammation.

Blood chemistry in the empyema cases showed a retention of urea nitrogen.

Acidosis was a factor in a large number of the bronchopneumonias at this camp, as was evidenced by a reduction of the combining power of blood plasma for CO_2 .

REVIEWS.

THE PRINCIPLES OF NURSING. By CHARLOTTE A. BROWN, R.N., Superintendent of Nurses in the New England Hospital for Women and Children; Graduate, City Hospital and Boston Lying-in Hospital Training School for Nurses; late Instructor in the Boston City Hospital Training School for Nurses. Pp. 255. Philadelphia and New York: Lea & Febiger, 1919.

MISS BROWN has written a book on nursing which is likely to be received with considerable enthusiasm by the nursing profession. The text is clear and brief. In fact, this would be the main criticism that one could offer. The brevity and the description in some of the procedures is such that it would be impossible to properly carry out the various steps unless they had been demonstrated before.

J. H. M., JR.

SURGICAL CLINICS OF CHICAGO. Vol. III, No. III. Pp. 287; 118 illustrations. Philadelphia: W. B. Saunders Company, 1919.

THIS number of the *Clinics* is an exceptionally interesting and instructive one. The number and character of the subjects treated make it especially valuable. The list of contributors contains the names of some of the most able men not only in Chicago but in this country.

Several very rare and perplexing conditions have been exploited, and their treatment outlined, such as cysts of the urachus, diverticulum of the esophagus, complete volvulus, stricture of the esophagus, etc. A very interesting article is included on sterility. Injuries of the joints, both in war and civil life, are discussed, as well as the most recent ideas on the surgical treatment of empyema.

The first contribution, on studies in paleopathology, although having but little bearing on present-day surgery, is most interesting from a historical viewpoint. It describes the most ancient of surgical practices—namely, trephining—and abundantly illustrates many specimen skulls, showing the various methods employed by different peoples scattered over the world as far back as the Neolithic times.

E. L. E.

PNEUMOTORAX ARTIFICIAL Y OTRAS INTERVENCIONES EN LA TUBERCULOSIS PULMONAR. Estudio critico y clinico por el DR. JUAN B. MORELLI, Profesor de Clinica Terapeutica de la Facultad de Medicina. Two volumes. Pp. 1247; 60 illustrations and 8 plates. Montevideo: Imprenta Nacional, 1918.

ARTIFICIAL pneumothorax, as a method of treatment for pulmonary tuberculosis, though systematized by Forlanini, in 1882, had been suggested by the English physiologist Carson in the second decade of the nineteenth century on the same grounds as recommended by Forlanini; and even before Carson's time it is known that Baglivi had observed two patients with phthisis who were markedly improved as the result of pneumothorax which followed gunshot wounds. The method, though known and employed in Italy from the time of Forlanini's early work, was scarcely known at all in other countries; in the United States it was independently proposed by John B. Murphy, in 1898, and its adoption on this continent is due largely to his teachings. Morelli was himself the first (1910) to adopt the method in South America.

The tuberculous process comprehends two stages: (1) Infiltration—which stage is curable by hygienic measures, and (2) caseation—which is incurable by hygiene alone, and which in the lung is always attended by surrounding inflammatory changes, leading to progressive destruction, owing to the constant movement of the lungs, this latter factor (constant motion) not being present in other structures such as bones and lymph nodes, which even when affected by tuberculous caseation are susceptible of cure much more readily than is the lung. The alternative methods of cure for this advanced stage of the tuberculous process, according to Forlanini, are *extirpation* of the diseased lung or its *immobilization*. The former method has been abandoned after sufficiently disastrous experiences; but to further popularize the latter method (immobilization) the present treatise has been prepared, based on Morelli's own large personal experience and on a painstaking and comprehensive study of the literature. The bibliography of the subject, assembled at the end of the work, occupies no less than thirty pages.

After the historical introductory chapter, Morelli proceeds to describe the apparatus and technic employed in the induction of artificial pneumothorax by Forlanini, Murphy, Brauer, Saugman and others who have specialized in this field of phthisiotherapy. There follow interesting chapters on the pathological physiology of artificial pneumothorax, including discussions of the mechanics of the pleural vacuum, pressure pneumothorax (open and closed), the composition of gases introduced into the pleura, their rates of absorption and the chemical changes which they undergo. He next discusses in more detail the ends sought to be gained and the

methods of introducing the gas at the first sitting and on subsequent occasions; the importance and interpretation of manometrical observations; the immediate effect on the patient; complicating factors such as adhesions; accidents occurring during the introduction of the gas or during the intervals between treatments; results of treatment; theories as to how pneumothorax produces these results; and finally a few chapters are devoted to other operations for the cure of pulmonary tuberculosis, such as the production of extrapleural pneumothorax, artificial pleural effusion, intrapulmonary injections, extirpation of the diseased portions of the lung, opening and draining of cavities, resection of the costal cartilages, section of the phrenic nerve, extrapleural plombage, etc.

It is impossible to give here more than a very brief summary of a few of the interesting topics treated at great length in this extensive work. The following items have been selected:

Artificial pneumothorax cannot be produced in from 15 to 25 per cent. of cases in which it is indicated, owing to pleural adhesions. In many patients the first injection produces such marked amelioration that too sanguine hopes of rapid and absolute cure are engendered. Usually complete collapse of the lung must be secured and maintained for a long time before any permanent results can be expected; but each patient has his individual optimum limit of collapse, and greater pressure and collapse than this optimum are harmful.

The results may be seen in the following statistics: Brauer and Spengler, in 1910, reported on 114 patients, of whom 26 were not suitable for this treatment, leaving 88 who were treated by artificial pneumothorax; of these 88, 27 (33 per cent.) were absolutely or relatively cured and 36 (40 per cent.) were improved, 6 were not improved and 19 died. T. Sachs (1915) assembled the statistics of North American authors covering 1147 cases, the results being known in 1108; in 15 per cent. treatment was prevented by adhesions, in 18 per cent. no improvement occurred and 16 per cent. died—or a total of 50 per cent. of non-success; 29 per cent. were improved and 21 per cent. were more or less completely cured; but when these apparent cures were traced for months or years it was found that actually only 12.3 per cent. remained finally cured.

Treatment by pneumothorax must be supplemented by hygienic and dietetic (superalimentation) measures. Forlanini thought it had no favorable action in cases of simple early tuberculosis, and reserved it for cases which had progressed to the stage of caseation; but Morelli believes it may be of benefit even in early stages, and suggests that the compression procures some form of serological reaction which proves beneficial. It is the most valuable known remedy against hemoptysis.

The injections are made under local anesthesia; the needle is thrust quickly through the skin and then pushed cautiously onward,

millimeter by millimeter, every two or three seconds, with constant manometric control; the appearance of negative pressure indicates that the pleura has been entered, which is preferably accomplished during an inspiration; respiratory oscillations will then appear in the manometer and the introduction of the gas may be commenced.

Some competent authorities (as Saugman) do not increase the pressure on the first injection above the neutral point between negative and positive pressure, except in cases in which, owing to adhesions, only a partial pneumothorax can be produced, when they permit a pressure $+5$, but even at subsequent injections they never allow the pressure to exceed $+20$ to $+25$. Forlanini, however, uses pressure up to $+60$ if the heart and mediastinum are not disturbed. The intrapleural pressure always falls gradually but steadily after the injections, in part owing to the evacuation (through the bronchi) of the residual air in the lung, and in part owing to absorption of the gas from the pleura. Forlanini teaches that an average of 100 c.c. daily is absorbed in the days just succeeding the injection; during the first year an average of 1 liter a month is absorbed. Morelli, however, considers these figures very much higher than the truth. In most cases the *intrapleural pressure* falls to 0 in twenty-four hours.

Physical and radiological examinations are necessary to indicate the most favorable site for the first puncture. Forlanini introduced only 300 to 400 c.c. on the first injection, and Morelli thinks better results are obtained by small amounts regularly introduced at short intervals than by larger amounts at irregular intervals. Every second or third day is often enough, but in urgent cases (as to check hemoptysis) the injection may be repeated on the same day. In the most favorable cases complete collapse will be secured in from fifteen to thirty days; but in the majority of cases phenomena of partial collapse of the other lung, of pain from rupture of adhesions on the same side, or other complication, necessitate the abandonment of regular injections before complete collapse can be obtained, and the course of treatment must be prolonged over several months. When collapse has at last been secured (as evidenced by the absence of visible pulmonary movement under fluoroscopic examination) it must be maintained by periodic reintroduction of gas. Usually a neutral pressure is best tolerated; but the presence of a resistant cavity which does not collapse with the rest of the lung, the failure of the patient to improve even when complete collapse is maintained or the presence of adhesions to the parietal pleura require a positive pressure. If occasional expansion of the collapsed lung is allowed to occur the patient invariably shows the bad effects of the change.

A. P. C. A.

RECONSTRUCTION THERAPY. By WILLIAM RUSH DUNTON, JR., M.D., Assistant Physician at Sheppard and Enoch Pratt Hospital, Towson, Maryland; Instructor in Psychiatry at the Johns Hopkins University; President of the National Society and of the Maryland Society for the Promotion of Occupational Therapy; Secretary of Maryland Psychiatric Society. Pp. 236; illustrated. Philadelphia and London: W. B. Saunders Company, 1919.

THE subject of occupational therapy and reconstructive therapy is of prime importance at the present time following the war, but it is a phase of medicine which should be carefully studied at all times on account of the frequency of industrial accidents, the large number of blind who are always with us, the feeble-minded and the mentally inefficient. The book is carefully prepared, is extremely suggestive and filled with splendid ideas. It will be of value to all those interested in proper education of those who have been so unfortunate as to be abnormal. J. H. M., JR.

COLLECTED PAPERS OF THE MAYO CLINIC, ROCHESTER, MINN. Edited by MRS. M. H. MELLISH. Vol. X, 1918. Pp. 1196; 442 figures. Philadelphia and London: W. B. Saunders Company, 1919.

THE Mayo Clinic volume for 1918 contains ninety-five papers by forty-six different authors, seven of whom (Balfour, Henderson, Judd, C. H. Mayo, W. J. Mayo, Rosenow and Stokes) have contributed more than five articles apiece. A suggestion made by the present reviewer, on a former occasion, has been adopted, and the list of contributors now contains information of the status of each in the Mayo Clinic and in the Mayo Foundation for Medical Education and Research, Graduate School, University of Minnesota.

Papers dealing with the alimentary canal occupy less than a fourth of the volume, those dealing with the head, trunk and extremities an equal space; while the remainder is devoted to the urogenital organs (90 pages), ductless glands (30 pages), heart (20 pages), blood (100 pages), skin and syphilis (120 pages), nerves (20 pages), technic (50 pages), and miscellaneous subjects (125 pages).

Probably the most important of these contributions is a series of papers by W. J. Mayo, dealing with the cirrhotoses of the liver. He advocates splenectomy as a method of "relieving the subnormal liver of its overload," and believes the mere mechanical relief secured the liver by shutting off such a large proportion of the blood normally delivered to it may prove beneficial, though he also recognizes the probability that splenectomy also reduces or eliminates a constant stream of infection sent to the liver from the spleen, the latter having strained out from the circulation its infectious con-

tents. In portal cirrhosis he thinks splenectomy should be considered as a means of relieving the overburdened liver; it is a procedure which is much more certain to secure the desired effect than is the attempt to shunt the portal circulation directly into the systemic by means of Talma's operation of epiplopexy with its associated maneuvers intended to create a collateral circulation. Of five patients with portal cirrhosis treated by splenectomy, Mayo says four recovered from the operation and were markedly improved. He suggests, as a further means of relieving the subnormal liver, the ligation and division of the inferior mesenteric or superior rectal artery and vein, a procedure which diverts all the blood from the territory tributary to these vessels from the portal system into the vena cava by way of the middle and inferior rectal veins. Yet the query propounded by Blake when this subject was under discussion by the American Surgical Association, remains unanswered: Does removal of the spleen diminish the *hepatic* circulation?

Portal cirrhosis, Mayo believes, is related to the defense function of the liver, being an attempt to encapsulate and destroy chemical poisons, especially when the spleen has become incompetent. He denies the existence of Hanot's cirrhosis, claiming such cases are either instances of hemolytic icterus or of ordinary "biliary cirrhosis." The former is primarily a disease of the spleen, with secondary work-hypertrophy of the liver, and he notes that in 50 per cent. of his own cases of splenectomy for hemolytic icterus, gall-stones have been present, with recurring attacks of infection.

The subject of biliary cirrhosis, however, is not so clear as is that of portal cirrhosis; apart from the fact of its infectious origin, and that it may exist in acute or chronic form, little is definitely known about it. Moreover, there is the disease known by Concato's name (1881) called polyserositis, and its subvariety, known as Pick's syndrome, in which the predominating symptoms are caused by the pericardial lesions. Between these affections and tuberculous peritonitis, and tuberculous effusions in the pleura and pericardium, the boundary line is not always clear.

Plummer has an interesting article on the blood picture in exophthalmic goitre; his conclusions are that lymphocytosis (average about 35 per cent.) is characteristic and therefore of value in diagnosis; and that leukopenia if present occurs at the expense of the polynuclears; yet that the blood picture is of no value in prognosis nor in determining the degree of severity of the disease. Pemberton's paper on blood transfusion gives an admirable historical summary, and contains records of more than 1000 transfusions by the citrate method, which he prefers to all others.

In view of the previous statistics and pathological studies published from the Mayo Clinic, it is interesting to note that Judd acknowledges (p. 204) that it seems probable that most gastric cancers begin as cancers—not as ulcers.

A. H. Logan contributes a good paper on chronic ulcerative colitis, illustrated with a remarkable series of skiagraphs.

It is surprising to read W. J. Mayo's expressions of admiration for the fact that in St. Mark's Hospital, London, *fistula in ano* and hemorrhoids have been well treated for more than forty years, and especially that he describes the operations for these affections as if unknown to fame. Attention is called to the matter by the reviewer for the same purpose that it is mentioned by Mayo—to promulgate the proper methods of operation if they are unknown.

Although all the papers in these annual volumes from the Mayo Clinic are published elsewhere in periodical literature, their preservation in collected form has become indispensable to the active surgeon; and the publishers and editor, no less than the various contributors, may feel that they continue to deserve well at the hands of the profession.

A. P. C. A.

MALARIA AND ITS TREATMENT IN THE LINE AND AT THE BASE.

By CAPTAIN A. CECIL ALPORT, R.A.M.C. (T.), M.B., CH.B., Edin., late Acting Major, Officer-in-Charge of the Medical Division of the Twenty-eighth General Hospital and of the Forty-first General Hospital, Salonika. Pp. 279. New York: William Wood & Co., 1919.

THE treatment of malaria is an extremely important phase of military medicine, particularly so among troops in the subtropical regions. Dr. Alport had a very extensive experience in the Balkans, and the results of this experience are embodied in the present volume. Much credit is due the author on account of the difficulties of doing literary and careful clinical work under the stress of active campaign. As he was far distant from reference libraries, the book is entirely a record of personal opinion and of personal results. For that reason it is of considerable value.

Dr. Alport advises the bihydrochloride salt of quinin, largely on account of its extreme solubility. Quinin is given by mouth, by intramuscular and by intravenous injection.

The author prefers giving quinin by intravenous transfusion, because, as he says, it is the most scientific and the most efficacious method of administration. It is as safe as any other method, and is not disagreeable. The quinin is given in amounts varying from 20 to 40 grains dissolved in 8 ounces of normal salt solution. There is danger of too great concentration of the quinin. At least 8 ounces of saline solution is the minimum amount that has proved correct and safe in the author's studies. Of course, it is not necessary to give quinin this way except in severe types of malaria.

In regard to the administration of quinin by mouth, it is recommended that it never be given in tablet form but given either as a powder or in solution, preferably solution, when possible. The intramuscular injections are not always pleasant nor entirely free from the danger of local nerve palsies.

Criticism of the author's methods of treatment are not exactly just if one considers the place and difficulties under which he worked. In mild cases of malaria he seems to give quite small doses of quinin over too long periods of time, and it is quite possible that the parasites in some of these patients become quinin-fast, a possibility which is apparently not recognized by the author. The outstanding criticism of the book itself is that it is too full of case histories to make easy or attractive reading, and it has too many illustrations of patients, some up and about, others in bed. Reference to the legend is necessary, in order to see if these soldiers are sick, recovering or entirely well.

J. H. M., JR.

TRENCH FEVER. By MAJOR W. BYAM, R.A.M.C., CAPTAINS J. H. CARROLL, U.S.R., J. H. CHURCHILL, R.A.M.C., LYN DIMOND, R.A.M.C., V. E. SORAPURE, R.A.M.C., R. M. WILSON, R.A.M.C., and L. LLOYD, R.A.M.C. With an introduction by LIEUT.-GENERAL SIR T. H. GOODWIN, K.C.B. Pp. 196; 48 charts and diagrams. London: Oxford University Press, 1919.

THIS book is an account of the Trench Fever Commission's work at Hampstead. They have definitely proved that trench fever is transmitted by the body louse; the head and body louse are the two varieties capable of this transmission. It is the excreta of the louse which is the damaging feature. In all probability the organism causing the disease undergoes some cycle or development within the louse, as they have been unable to cause the disease before five days after the louse has fed upon an infected individual. The infective power of the louse has been proved to be at least twenty-three days. The excreta from a single louse has been sufficient to cause trench fever in an adult. Whole blood taken from a vein of a patient is capable of producing the disease in a healthy adult when given into a vein. The plasma alone is not capable in doing this. They call attention to the presence of Rickettsia bodies, but do not believe they are the causative factor. All experiments are recorded fully, testing out the modes of transmission, virulency of the virus, etc. Experiments were made upon men who volunteered for this purpose. They divide the fever into five different types, giving the symptomatology, pathology, prognosis and treatment of the disease as a whole. They have proved that one attack confirms a certain degree of immunity.

Eighty-five per cent. of the cases treated recovered. The remainder of the chronic cases assumed the same symptomatology as the disordered heart cases, and all feel that trench fever is one of the most important etiological factors in this affection. A chapter is devoted to geographic distribution and another to the prophylaxis of the disease.

In the appendices the experiments are recorded more fully. A summary of the report of the commission of the American Red Cross Research Committee on Trench Fever is also appended. The results of both bodies are practically the same. A great deal of credit should be given these workers, as well as those who volunteered for the experiments, as the knowledge gained is of extreme value to all communities of the world.

T. K.

THE NERVOUS HEART: ITS NATURE, CAUSATION, PROGNOSIS AND TREATMENT. By R. M. WILSON, Captain, R.A.M.C., Cardiologist to the Trench Fever Research Committee, and JOHN H. CARROLL, Major, M.C., U.S.A., Instructor in Clinical Medicine, University and Bellevue Hospital Medical College. Pp. 136; 55 illustrations. London: Oxford University Press, 1919.

THIS volume is the result of much research work done at the military hospital at Hampstead and Mount Vernon. The authors have attacked the nervous heart problem from the standpoint of the vagus depressor and sympathetic nervous systems, at all times feeling that an infection or a toxemia is the primary basis for the break in the normal relation between these two nervous systems. The infections are again divided into the acute, such as pneumonia, diphtheria, scarlet fever, etc., in which eventually all evidences of toxemia will disappear with the subsequent recovery of the patient; and into the more chronic such as trench fever, tuberculosis and rheumatism. These cases are, as a rule, the unfavorable cases as to recovery. The symptomatology of the disease, breathlessness, giddiness, precordial pain, pulse-rate and the vasomotor phenomena are all explained from the sympathetic and vagus depressor viewpoint. The treatment is based upon the removal of the infection or toxemia; secondarily, the palliative treatment consists of personal reassurance of freedom of serious cardiac disease, encouragement to return to vocational work in the same environment as formerly, and in addition graduated exercises to stimulate the sympathetic system to respond more freely to the hypersensitive vagus. Thyroid extract and atropin have been the only two drugs of value in these cases.

The work is undoubtedly a step in the right direction toward finding an explanation upon a physiological basis of this condition.

T. K.

TRANSACTIONS OF THE SECTION ON GENITO-URINARY DISEASES OF THE AMERICAN MEDICAL ASSOCIATION. CONTRIBUTED BY TWENTY-ONE MEMBERS. Pp. 260; 30 illustrations. Chicago: American Medical Association.

A VOLUME well in keeping with its splendid predecessors, containing seventeen essays of the highest character and of great surgical interest. An especially valuable contribution is by J. T. Geraghty on an intimate study of one hundred and forty-five cases of bladder tumor, outlining the close differential diagnosis and giving the technic of treatment by fulguration and radium and his results. This is followed by B. S. Barringer detailing his technic with radium needles in cancer of the prostate. The symposium on lithiasis, by E. W. Caldwell, L. T. Le Wald, E. L. Young and H. G. Bugbee, is a second valuable study in diagnosis and treatment. The paper by F. W. Robbins and F. P. Seabury on their new method of treating chancroid, which has so revolutionized the treatment of these cases, should be studied and followed to appreciate its full importance.

A. R.

A MANUAL OF EXERCISES FOR THE CORRECTION OF SPEECH DISORDERS. By MAY KIRK SCRIPTURE, B.A., Instructor in Speech, Columbia University; Director of Speech Correction, Vanderbilt, etc., and EUGENE JACKSON, B.A., in Charge of Speech Correction at the University of Bellevue Hospital Medical College Clinic, New York City, etc. Pp. 136; 46 illustrations. Philadelphia: F. A. Davis Company, 1919.

THIS book is really the second volume of two small manuals devoted to the subject of speech defects. The first volume deals with the defects themselves, their etiology, diagnosis and therapy. The second volume, which is this manual, is simply an exercise book for both teacher and pupil. In this work there is no attempt to correlate the various exercises with any specific speech disorder, but it is simply a well-written, properly illustrated series of exercises intended to establish a normal speaking ability. There is an introduction in which various breathing exercises, mouth gymnastics, suggestions for teacher and necessary teaching implements, etc., are described. The rest of the book consists of fifty daily lessons arranged progressively, covering the various procedures and exercises which in the opinion of the authors are the best aids to proper voice control and speaking ability.

This manual should be used in connection with Volume I of this series, and the two make good text-books for the use of those who are devoting themselves to the correction of speech disorders.

G. B. W.

PROGRESS OF MEDICAL SCIENCE

THERAPEUTICS

UNDER THE CHARGE OF

SAMUEL W. LAMBERT, M.D.,
NEW YORK,

AND

CHARLES C. LIEB, M.D.,

ASSISTANT PROFESSOR OF PHARMACOLOGY, COLUMBIA UNIVERSITY.

The Effects of Influenza on Pulmonary Tuberculosis.—Although the number of cases observed by STIVELMAN (*New York Med. Jour.*, July 5, 1919, p. 20) were too few for definite conclusions, he calls attention to the following instructive facts: (1) The influenza epidemic appeared at the sanatorium several weeks later than in New York City (which is forty miles south) and only forty-eight hours later than in the nearest village, a half-mile from the institution. (2) Tuberculous and non-tuberculous subjects appeared to be equally susceptible to the infection, the incidence in both cases being 24 per cent. (3) Early and advanced cases of tuberculosis were equally affected. (4) Pneumonic consolidations occurred as frequently in the non-tuberculous as in the tuberculous. (5) The mortality of the epidemic was 11.4 per cent. (6) Careful observation for four months and re-examination of all patients so affected at the end of this period showed that all the patients but two were none the worse for their experience, their general condition being as good as might have been expected normally. (7) So far there seems to be no increase in the number of tuberculous patients seeking admission to the sanatorium as a result of influenza, and more cases are erroneously sent to us for treatment on account of basal lesions than in corresponding periods of the past two years.

The Effects of a Scorbutic Diet on the Adrenal Glands.—McCARRISON (*British Med. Jour.*, August 16, 1919, p. 200) found that the weight of the adrenals of guinea-pigs dying in consequence of the scorbutic diet (crushed oats and autoclaved milk) is approximately double that of health; this increase is even more marked when the weight of the glands is calculated per kilo of original and of final body weight. The

histopathological changes are hemorrhagic infiltration and disintegration of the cellular elements of the cortex and medulla. These changes are to be regarded as pre-scorbutic in character, as they may occur in animals which exhibit no clinical evidence of scurvy during life. In spite of the greatly increased weight of the adrenal, the total quantity of adrenalin in the two glands is less than half that present in healthy guinea-pigs, while the total adrenalin per gram of gland is less than one-fourth of the normal. In healthy pigeons the total adrenalin per gram of gland is approximately ten times greater than in normal guinea-pigs. In pigeons deprived of accessory food factors there is a great increase in the adrenalin content of the adrenals; the actual adrenalin content is largely dependent on the class of accessory food factor absent from the dietary. When, for example, material containing accessory food factors of class "A" is added to a diet of autoclaved rice the adrenals usually show a normal amount of adrenalin. It appears that lack of factors of the "A" class with excessive production of adrenalin is associated with the occurrence of edema in aves, and that in guinea-pigs lack of factors of the "C" class, with diminished production of adrenalin, is associated with hemorrhage into the body tissues.

Liquid Paraffin for Disinfecting Needles and Syringes.—WATERHOUSE (*British Med. Jour.*, August 2, 1919, p. 136) recommends the use of liquid paraffin, which boils at 360°C ., for disinfecting needles, syringes, etc. A simple method is to heat the upper part of a test-tube three-quarters full of liquid paraffin until currents appear (about 150°C .) or rather longer, draw the heated fluid at once into the syringe until it comes into contact with the whole of its interior and then eject it. Caution is needed in heating the paraffin or it may spurt. The advantages of this method are the rapidity and simplicity with which complete sterilization can be effected at the bedside and the absence of deleterious effect upon the needle, which never rusts and remains patent and useful as long as it can be kept sufficiently sharp. The method is particularly useful for needles and syringes for giving intramuscular injections of mercurial cream.

Dakin's Solution.—In the *British Med. Jour.*, May 17, 1919, p. 611, ATTWATER gives the following simplified method of preparing Dakin's solution. Dr. Dakin himself has expressed his approval of the modification advocated. The quantities required for about 10 liters of solution are: chlorinated lime, about 156 gm.; sodium carbonate (anhydrous), half above quantity; sodium bicarbonate, five-twelfths the above quantity. The exact quantities used are immaterial provided they are used in proportion 12 to 6 to 5. The chlorinated lime is dissolved in 5 liters of water, stirred frequently and allowed to stand for from six to twelve hours. 10 c.c. of this solution, 20 c.c. of 10 per cent. potassium iodide solution and 2 c.c. of strong CH_3COOH are then taken and the whole titrated against a decinormal solution of $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$. If the burette reading is r c.c. the remaining two ingredients are dissolved in $\frac{7r-90}{18}$ liters of water, then mixed with the initial solution

and allowed to stand for one hour. The supernatant liquid is siphoned off and filtered; the filtered product is Dakin's fluid of the required

strength, showing no trace of free alkali. The advantages of this method are: (1) the time of preparation is reduced by one-half; (2) no sensitive chemical balance is necessary (except when the preparation of the standard solutions for testing is also undertaken; (3) instead of preparing a separate sample of $\text{CaO}(\text{Cl})\text{Cl}$ to ascertain the percentage of active chlorine the liquid in bulk is itself tested; this is not only quicker but eliminates the chance of errors; (4) the necessity of powdering the chlorinated lime before taking representative samples is obviated.

Dose and Methods of Administration of Diphtheria Antitoxin.—SEARS (*Albany Med. Ann.*, July, 1919), following the rule of Schick, states that 100 units of diphtheria antitoxin should be given for each kilogram of weight. Thus, 1000 units should be given to a child weighing 22 pounds; 2000 units to a child weighing twice as much; and for a normal adult weighing 132 pounds, 6000 units is the correct amount. For purposes of immunization, one-half the therapeutic dose is sufficient. Before giving the serum it is advisable to test the patient's sensitivity to horse serum, either by giving a very small dose (0.1 c.c.), and repeating in twenty minutes with twice the amount and then gradually increasing the dose, or the Schick technique may be used to inject a minute quantity of the serum intradermally. In mild cases of diphtheria, Sears advises the subcutaneous method of administration, or, if rapid absorption is desired, the serum may be injected intramuscularly. In fulminating cases the serum should be given intravenously.

An Investigation of the End-result in One Hundred and Twenty-four Cases of Blood Transfusion.—The following is a brief *résumé* of the results obtained by WAUGH (*British Med. Jour.*, July 12, 1919, p. 39) in a series of blood transfusions carried out in a base hospital in France between November, 1916 and October, 1918. The method employed was indirect transfusion by Vincent's paraffin-coated tubes. The amount transfused was usually 600 c.c. Compatibility was established first by direct comparison of the bloods under the microscope, later by obtaining Group IV donors by the convenient macroscopic method introduced by Lee. The main indications for the employment of transfusion were (Class I) severe secondary hemorrhage; (Class II) preliminary to high amputation of thigh or arm; (Class III) certain cases of pyemia. Class I. (a) Secondary hemorrhage; ligation of main artery; (b) secondary hemorrhage; amputation of limb. (a) Transfused, 52; death-rate, 32.7 per cent.; not transfused, 52; death-rate, 46.1 per cent.; (b) transfused, 14; death-rate, 28.5 per cent.; not transfused, 14; death-rate, 50 per cent. Class II. Sepsis or gangrene; amputation of limb. Transfused, 39; death-rate, 10.2 per cent.; not transfused, 29; death-rate, 31 per cent. Class III. Pyemia. Transfused, 19; death-rate, 36.8 per cent.; not transfused, none. Totals, transfused, 124; death-rate, 25.8 per cent.; not transfused, 95; death-rate 42.2 per cent.

The Cure of Multiple Warts on the Face.—IND (*British Med. Jour.*, July 5, 1919, p. 11) recommends the following treatment for the cure of small, multiple warts on the face: The warts and the skin around were painted three times a day for one day with a saturated alcoholic solution of salicylic acid. On the following morning the warts were cut off by a

flat, sharp steel instrument, bevelled on one side only; this passes freely over the healthy skin, but cuts off the warts, leaving only slightly bleeding-points. The surface is then painted with the salicylic solution and twice more during the same day, three times in all. This turns the little red points to a brownish-black color, tiny scabs form which are allowed to drop off, taking about a week to do so, and leaving a perfectly clear healthy skin. The skin is bathed with pure alcohol once a day until the scabs have all dropped off. With this treatment there is neither pain nor scarring, sepsis does not occur and there is no recurrence of the multiple growths.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Fat Metabolism of Infants and Children.—HOLT, COURTNEY and FALES (*Am. Jour. Dis. Children*, September, 1919) continue their observations on the fat metabolism of infants and children. This article concerns the digestion of vegetable fats by children on a mixed diet. They found that the stools of children receiving a considerable proportion of vegetable fat did not differ essentially in appearance from those of children receiving mainly milk fat, although they were usually somewhat softer. The fat percentage of dried weight of the stools averaged somewhat lower when nut butter was taken, and somewhat higher when corn oil was taken, than when the fat in the diet was mainly milk fat. When larger quantities of corn oil were added to the diet the average was much higher. The soap percentage of total fat in the stools was usually a little lower and the neutral fat a little higher with vegetable fat than when the fat of the diet was mainly milk fat. When nut butter was taken the fat excretion in the alkaline stools was lower and in the acid stools it was higher, than when the diet did not contain vegetable fat. When corn oil was taken in considerable amounts the fat excretion in the stools was higher than when the fat of the diet was mainly milk fat. The total fat intake when corn oil was included in the diet was very large and the actual retention of fat always much higher than the normal average for a mixed diet. When vegetable fat formed a considerable part of the total fat intake, the percentage of the fat intake retained was usually higher than the normal average. In a few instances when the stools were acid and in a few when large amounts of corn oil were taken, the percentage retained was low. Individual children observed for considerable periods with changes in the kind and amount of fat intake showed quite as good digestion of vegetable fat as of corresponding amounts of milk fat and no unfavorable effect on general health and nutrition was observed. No children were kept long enough on a diet presumably deficient in fat-soluble A or fat-soluble vitamin to warrant any conclusions as to the effect of such a diet upon growth

and health. One child who was on a diet in which there was no definite source of fat-soluble vitamin, 95 per cent. of the diet being corn oil, ceased to gain in weight on this diet for a period of five weeks, but showed no loss in weight and the general health was unimpaired. Six children, 80 to 95 per cent. of whose fat intake was vegetable fat showed lowered vitality, two developing styes and two others eczema upon the face, which disappeared when the diet was changed to include milk fat. Corn oil and nut butter are valuable foods for children, and are exceedingly well borne and are apparently digested and absorbed with ease. These articles may be safely introduced into the regular diet of children, and then to a considerable degree may be substituted for the more expensive milk fat, given either as milk or butter, but they should never entirely replace milk fat.

Experimental Hydrocephalus.—DANDY (*Ann. Surg.*, August, 1919) in this article has made a valuable contribution to the extremely scant knowledge of this condition, which often occurs in a most inexplicable manner. His work was done on dogs. He was able to produce hydrocephalus by placing an obstruction in the Aqueduct of Sylvius. Dilatation of the third and both lateral ventricles followed this experiment. When one foramen of Monro was occluded it was followed by a unilateral hydrocephalus. When the choroid of one lateral ventricle was completely removed at the time the foramen of Monro was occluded there was not only no dilatation, but the entire lateral ventricle collapsed. This was the only absolute proof that the cerebrospinal fluid was formed from the choroid plexus. At the same time it proved that the ependyma does not secrete cerebrospinal fluid. When the choroid plexus of both lateral ventricles were removed, and an obstruction was placed in the Aqueduct of Sylvius, hydrocephalus still resulted in the third and both lateral ventricles, but at a reduced rate. The fluid formed from the choroid plexus of the third ventricle but could not escape into the subarachnoid space. He showed that cerebrospinal fluid forms in all the cerebral ventricles, and that it is absorbed almost entirely in the subarachnoid space. The sole communication between the ventricular system and subarachnoid space is through the foramina of Luschke and the median foramen of Magendie. The phenolsulphonephthalein test will prove conclusively whether the foramina of Luschke and Magendie are open or closed. Closure of these foramina invariably cause hydrocephalus. Hydrocephalus followed ligation of the Vein Magna Galeni when the ligature was placed at the origin of this vein. Ligature beyond or in the sinus rectus had no effect because there is sufficient collateral venous circulation. The communicating type of hydrocephalus was produced in dogs by a perimesencephalic band of gauze, saturated in an irritant which produced adhesions. This obstruction prevents cerebrospinal fluid from reaching the cerebral subarachnoid space, where most of the cerebrospinal fluid is absorbed. The resultant diminished absorption of fluid results in hydrocephalus. Hydrocephalus followed ligation of the great vein of Galen because of an overproduction of cerebrospinal fluid. In other types of hydrocephalus, both obstructive and communicating, the accumulation of fluid is due to a diminished absorption of cerebrospinal fluid.

Backward, Nervous and Delicate Children.—MCCREADY (*Pennsylvania State Med. Jour.*, September, 1919) calls attention to the fact that many of the causes of nervous and mental deviation, with their constitutional basis are controllable if the manifestations are recognized early enough. He says that constitutional inferiority or hypoplasia may be due to causes which are hereditary or acquired or a combination of both. Hereditary hypoplasia is due to defects in the chromosomes of the ovum or spermatozoön of the parents. Environmental hypoplasia is due to toxemia in the parent or parents affecting the ovum or the spermatozoön or both. It may be due to toxemia in the mother or to local disease in the endometrium. It may also be due to bad environment in postnatal life. The child at birth may give evidence of insufficient vital energy such as underdevelopment and asthenia. Asphyxia, especially when followed by convulsions, should require careful investigation for evidence of intracranial pressure. Convulsions during infancy and early childhood usually indicate an unstable nervous system. Chorea is likewise a matter of greater importance than is commonly supposed. Difficulty in feeding, acidosis, enuresis, underweight and the visceroptotic habit, overweight with pudgy extremities and phlegmatic temperament are conditions that demand more consideration than are usually given to them. From a psychic standpoint extreme timidity or its opposite—undue aggressiveness, night terrors, excessive imagination, phobias, compulsive ideas, pathological lying, and extreme egoism call for investigation and correction. Premature eroticism resulting in infantile masturbation and childhood perversion of the sex instinct are frequently associated with a neurotic constitution and should be studied carefully for the purpose of determining the best method of treatment. Treatment of these cases should include all measures, medical, hygienic and educational which have for their purpose the stimulation of the correlative forces of growth, the elimination of waste products, the development of the psychomotor and emotional control, and the cultivation of the higher faculties of the mind.

Toxic Properties of Milk.—FORD (*Am. Jour. Dis. of Children*, September, 1919) presents evidence which shows that when milk, previously heated to 80° or 85° C. for from twenty to thirty minutes, is allowed to decompose it contains bacteria and their products which are capable of giving rise to an acute death in small animals such as rabbits and guinea-pigs on subcutaneous inoculation. This is a true intoxication since the bacterial products when freed from bacteria by filtration through Berkefeld filters are always poisonous and bring on fairly definite changes in animals. Milk cultures of *Bacterium welchii* are also poisonous and this poisonous action is likewise due to a toxic or poisonous principle present in the milk. The fact that the gas bacillus is the predominant organism in heated market milk and the similarity of action on animals of the heated milk and the milk culture of the gas bacillus make it a reasonable conclusion that the poisonous quality of the decomposed milk is to be attributed to the development in it of this species which is always present in the spore form. The fact that the point of heat destruction of the milk toxin is somewhat higher than that of the gas bacillus toxin may be explained on the assumption that the

market milk may contain other substances than those produced by the gas bacillus, either protein decomposition products or the secretory products of other bacteria, either aërobic or anaërobic in character. It should be said that the toxic substance present in milk cultures of *Bacterium welchii* is also at times thermostabile and may resist a temperature of 70° to 80° C. The exact relation of the toxic substance formed in milk cultures of this species to the toxic substance recently described by Bull and Pritchett, and shown by them to act as an antigen is not clear. Filtrates from the milk cultures are powerfully hemolytic, and some of their poisonous action may be due to blood destruction. The pathologic picture is not that of a pure hemolytic intoxication, as evidenced by the lack of hemoglobinuria and in many instances the animals die acutely without signs of local blood destruction. It is possible that there are two distinct substances in the milk cultures: one hemolytic and present in considerable quantity and destroyed at about 60° C., in thirty minutes, and one toxic, usually resisting a temperature of 60° C., but produced irregularly. The latter is probably identical with the gas bacillus investigated so carefully by Bull and Pritchett. The demonstrations of these materials in heated milk should be kept clearly in mind in the consideration of the problem of milk pasteurization. Under all circumstances milk heated to temperatures sufficient to destroy vegetative bacteria but not their spores should be kept at a low temperature to prevent the development of these spores and should be used within a short time after the heating. Whether the bacterial products found in this decomposed milk have any poisonous action when taken into the digestive tract has not been determined, but in view of their presence in milk the practice of keeping pasteurized milk for any considerable period of time should be avoided. The occurrence of toxic substances in heated milk arising from the development of spore-bearing bacteria requires a rigid supervision of milk production before pasteurization to prevent the entrance of organisms of this kind.

Cerebrospinal Involvement in Hereditary Syphilis.—JEANS (*Am. Jour. Dis. of Children*, September, 1919) gives the results of the routine observations on all children with syphilis coming to the Washington University Dispensary. Seventy-eight children under two years of age and 136 over two years of age were studied in regard to nervous system involvement. Besides being studied neurologically fundus examination of the eyes were made. The chief purpose of the study was to show the frequency with which the central nervous system is seriously involved in hereditary syphilis. It is usually conceded that if the cerebrospinal fluid gives a positive reaction to the Wassermann test, there is involvement of the central nervous system. The findings of increased cells, globulin, albumin and a positive colloidal gold test though important has not the same significance as the positive Wassermann. Of the 78 infants the serum of all but 1 gave a strongly positive Wassermann reaction. The exception was an infant, one month old, who had a rash, rhinitis and infiltration of the palms and soles. The cerebrospinal fluid of 31 of these infants gave a positive Wassermann reaction. Of these 11 were four plus, 1 was three plus, 10 were two plus and 9 were one plus. Of the 9 one plus reactions 8 were in infants under three months of age, which might be too early for the Wassermann reaction

to be strongly manifest even though the nervous system might be definitely involved. In 6 of these 9 instances the cerebrospinal fluid gave other evidence corroborating the positive reaction. Three were not otherwise examined, but in 1 a later specimen of cerebrospinal fluid gave a four plus Wassermann. Eleven of the 31 infants whose cerebrospinal fluid gave positive Wassermann reactions had clinical signs of neurosyphilis. The signs manifested were chiefly those of meningeal involvement with evidence of deeper involvement in 3. Three patients with convulsions were seen at the ages of three years, three and ten months respectively, soon after the onset of the convulsions. One patient with neck rigidity and other signs of meningitis, but without convulsions, was seen soon after the onset at the age of seven months. Four patients with moderate grades of hydrocephalus were seen at the ages of five and one-half, six, nine and eleven months respectively. Two patients with optic neuritis were seen at the ages of one and one-half and three months, respectively. One patient with hemiplegia and hydrocephalus was seen at the age of eighteen months. Of the 136 children from two to fourteen years of age, 70 have been classed as having a clinically active infection, and 66 as having a latent infection. All but one gave a positive Wassermann reaction in the serum. The exception was a child who had an acute dementing process and whose cerebrospinal fluid gave complete fixation. The children classed as having a latent infection were for the most part brothers and sisters of children having clinically active syphilis. Some of the children having latent syphilis had scars or similar signs of former lesions, but most of them had no signs or symptoms whatever except a positive Wassermann reaction. Of the 70 actively syphilitic 22, or 31 per cent., had a positive cerebrospinal fluid Wassermann. Of the 66 latent cases 13, or 20 per cent., had positive cerebrospinal fluid Wassermann reactions. Of the total 136 older children 35, or 25.8 per cent., had positive cerebrospinal fluid Wassermanns. Of these, 25 had symptoms or signs referable to the central nervous system. In addition to the 22 patients with active syphilis these 25 include 3 with fixed pupils who had no other signs of activity than a positive Wassermann reaction and who were therefore classed as latent. Of these 25 having clinical signs of neurosyphilis 12 had gross mental defect. The more superficial or meningeal symptoms occurred as follows: 2 had acute meningitis with convulsions at three and four and one-half years respectively; 1 had meningitis without convulsions at four years of age; 5 had chronic convulsions which were classed as epilepsy; 2 had arrested hydrocephalus. The submeningeal manifestations occurred as follows: 6 had hemiplegia; 1 had spastic quadriplegia; and 1 had spastic paraplegia; optic atrophy was seen five times, twice with associated lesions; fixed pupils without optic atrophy were seen four times; 1 patient had an acute dementing process; 1 had juvenile paresis and 2 others had sensory changes with the cerebrospinal fluid reactions of paresis. Two of these latter had optic atrophy. The nervous system was involved in 40 per cent. of syphilitic infants, 31 per cent. of older children having active infection and 20 per cent. latent infection. Of the entire group of 214 infants and children the nervous system was involved in 70, or 32.7 per cent. Of those having positive cerebrospinal fluids slightly more than one-third of the infants and slightly more than two-thirds of the older children had clinical manifestations of neurosyphilis at the time of observation.

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

Labor Complicated by the Funnel-pelvis.—WILLIAMSON (*Am. Jour. Obst.*, October, 1918) reports 106 cases of funnel-pelvis. This was 7.7 per cent. of the number of women examined. Most of these patients were white and the greater number were delivered in the service of the Manhattan Maternity Dispensary New York. The pelvis was considered to be of the funnel type when the transverse diameter of the outlet was 8 cm. or less. Normally this diameter is 11 cm. These patients were first measured in the routine way and then the transverse diameter was measured as follows: A Budin pelvimeter was held by a nurse, the tips were crossed and grasped between the thumbs and index fingers and forced gently, but firmly between the tuber ischii. This measure was taken as the transverse diameter. In all cases having 8 cm. or less, the posterior sagittal diameter was measured. This was done by placing the patient in the lithotomy position, drawing her down upon the table so that it was possible to measure over the sacrococcygeal joint and to midway between the tuber ischii. From this reading 1 cm. was deducted for the thickness of the sacrum and soft tissues. The pubic arch was palpated by the Sellheim method. The cases were divided into absolutely contracted, with transverse diameter 5.5 cm. or under and the relatively contracted between 5.5 cm. and 8 cm. The pelves were divided into three classes: one in which the transverse diameter was from 7.75 cm. to 8; the next between 7 cm. and 7.5 cm. and the third where the transverse diameter was below 7 cm. In 106 cases delivered there were 95 typical funnel type pelves; 10 generally contracted and one flat funnel. Various authors have given measurements under which spontaneous delivery is not likely. Among these patients 65 were delivered spontaneously and 41, or 38 per cent., were delivered by some operation. Most of the operative cases were forceps deliveries. Cesarean section was performed four times. Pubiotomy twice for generally contracted funnel pelvis. In the first of these there was breech presentation and pubiotomy was necessary to free the after-coming head. Both these mothers made good recoveries. One child died after delivery. Labor was induced in 3 cases and in 1 of these a Cesarean section was done after the abduction. In choosing the time and method of delivery it is not a question as to whether the patient has a contracted outlet of the pelvis, but what the actual conditions present are as developed during labor. So far as spontaneous labor was concerned $7\frac{1}{2}$ cm. transverse with 7.5 cm. posterior sagittal diameter would usually permit the birth of a living child spontaneously. In these cases there was a high percentage of perineal lacerations, 53 per cent.; there were three lacerations extending into the rectum and on 3 cases symphyseotomy was performed. One mother died; 12 infants died or were stillborn; 4 where death could be traced in some degree to operation.

It is thought that the measurement of the transverse diameter of the outlet should always form part of the general measurement of the pelvis. It is difficult to tell how important a factor this may be as there is no way of accurately knowing the size and the consistence of the fetal head. In cases of absolute contraction Cesarean section should be performed at or just before term. Where the case is one of moderate contraction labor may be induced in from thirty-seven to thirty-eight weeks. *If bougies are used there is a possibility of infection and also of displacing the presenting part and thus interfering with the mechanism of labor.* In children born by induced labor at thirty-seven or thirty-eight weeks the fetal heart should be carefully watched for such children are not as vigorous as those at term. Forceps will usually succeed in delivering these cases because there is a considerable rotation at the sacro-iliac joints in the patient placed in the lithotomy position. In delivering the head in these cases traction should be made downward even at the expense of considerable laceration. If forceps fails section should not be chosen because of the danger of infection. In selected cases pubiotomy may give good results, but the danger of infection and hemorrhage accompanying this operation must be remembered.

The Result of Induced Abortions as Disclosed by Abdominal Section.
—REDER (*Am. Jour. Obst.*, December, 1918) had an opportunity of examining 8 cases of sterilization the result of induced abortions. All of the women were married, in good health and none over thirty-five years of age. In each case the abortion was induced soon after the first period had been missed, generally in the second or third week. A catheter or sound was introduced and sounds usually followed within five days. Before the employment of instruments, hot-water douches; *hot foot-baths, mustard applications to the lower abdomen,* and in 4 of the cases medicines such as ergot or pennyroyal had been tried without success. Of these 8 women 3 had five abortions in two years; 2 six in two and a half years; 1 nine in three years; 1 eleven in three years and 1 fourteen in five years. None of them was seriously sick. A few remained in bed for several days. No physician was consulted. After a week the discomfort usually had passed and the patients did as they were accustomed. Menstruation, however, was irregular, painful and often profuse for months after. In 5 of the 8 this was permanent, while in the other 3 menstruation became normal; 6 had chronic leucorrhea. All had more or less backache, and each abortion increased the severity of the backache. Apparently the general health had not been impaired nor had the pelvic organs been damaged to any serious extent. These patients subsequently desired children and submitted to gynecological treatment, with the hope of making conception possible. When these women were submitted to abdominal section in 7 out of the 8 the abdominal end of the Fallopian tubes was closed, and this was a positive factor producing sterility. In 5 of the 8 there was bilateral hydrosalpinx. In 2 the hydrosalpinx was unilateral. The opposite tube in the latter cases was collapsed and presented a sacculated appearance, the lumen giving evidence of a number of strictures. In 1 case there was no hydrops of the tube, but the tubes were sacculated and the uterine ends were closed. In each case the tubes were down in Douglas's pouch, usually bound down with adhesions and false membranes. On

the left side the tube was buried under the sigmoid, while on the right it was attached by adhesions to the cecum and the appendix. There were no pathological processes in the ovaries. None was in its normal position. All were prolapsed and adherent to the tube. In several cases the ovary, tube, uterus and rectum were matted together. All of the ovaries gave evidence of cystic degeneration. Some were twice their normal size. In over half the cases there was great thickening of the surface of the ovary and all the ovaries were more or less cystic. In most cases the uterus was backward, fixed by adhesions. In treating these cases conservatism was followed; adhesions were freed and the organs brought as nearly as possible into their normal condition and position. The closed ends of the tubes were opened and the tissues were cuffed back and the tubes explored with a sound. The ovary was fixed as near the opening of the tube as possible, and in some cases the abdominal end of the tube was sutured to the ovary. Cystic material in the ovaries was excised as much as possible. Two of the patients became pregnant and went to full term within twenty months after the operation. These two had bilateral hydrosalpinx, and resection of both ovaries was necessary. They were the youngest of the series, one twenty-six the other thirty. The remaining six women were operated on within the last four years, but have not yet conceived.

Cesarean Section under Local Anesthesia.—The possibility of performing Cesarean section under local anesthesia is illustrated by BROWN (*Am. Jour. Obst.*, December, 1918) in a multipara suffering from mitral stenosis with asthma. There was marked decompensation. The patient's condition was so grave that she could not be moved from her bed. She was given local anesthesia and an operation was performed with the patient in the sitting posture. After the operation she was given free doses of strophanthus and digitalis and recovered sufficiently to leave the hospital and remain in good health for some time. A severe case of toxemia of pregnancy was relieved by Cesarean section under local anesthesia. Both mother and child recovered. The writer also described the case of a tuberculous woman in whom a bag failed to set up labor. The child was small and there seemed every reason to think spontaneous labor would develop. The bag was expelled through the cervix in seven hours without setting up labor. The child was delivered by abdominal section under local anesthesia. The mother gained weight rapidly after the operation and her general health greatly improved.

Two Cases of Cesarean Section with Denuded Lower Segment.—DORMAN (*Am. Jour. Obst.*, December, 1918) performed Cesarean section on two patients in whom the uterus was retracted from the child. The lower segment was so thin that in extracting the child it was difficult to prevent a laceration into the bladder. In one case the obstruction to labor had been a sharp promontory of the sacrum. In this case there was some difficulty in closing the irregular wound of the uterus and there was moderate bleeding. The patient made a good recovery. In the second case the operation was complicated by omental adhesions. The lower segment was torn during extraction down to the bladder wall and the suturing of the tear was difficult.

Normal Delivery Followed by an Unusual Complication.—STEIN (*Am. Jour. Obst.*, March, 1919) illustrates the uncertainty of obstetric cases by describing the following: The patient, aged thirty-one years, was pregnant for the second time, with a negative history as regards illness. The first child had been born five years previously and its eyes had been infected, requiring treatment for some time. The husband had had gonorrhea several years before his wife's first confinement, but at the time of the confinement he was perfectly well. She had been seen during pregnancy and was always found in good condition. Spontaneous labor developed without examination by anyone and terminated in the birth of a living child. The placenta was expelled in the usual manner and the whole confinement was without incident or complication. Immediately after delivery the patient complained of excruciating pain in the right sacro-iliac region, with a temperature of 101.6° , the next day reaching 104° . The pulse was 140. The patient kept up this temperature and pulse with intermissions for nearly two months. The pain in the sacro-iliac joint was the result of strain of the joint, and strapping gave some relief. An examination of the blood showed the *Streptococcus pyogenes* and the patient was given antistreptococcic injections for three weeks, as much as 20 to 30 c.c. daily. On the tenth day a swelling appeared at the left knee, which on puncture was found to contain purulent material with the *Streptococci pyogenes*. When the patient left the hospital she was unable to walk on account of the pain in the sacro-iliac joints, but was permitted to go home, using crutches. She finally had a brace, which gave her considerable help. When the final examination was made nothing abnormal could be found. Two weeks later she developed high temperature and pulse and a mass in the right groin. The right thigh became swollen and edematous. A large mass developed above Poupert's ligament, the right thigh was swollen and edematous and on internal examination a large abscess was found, originating apparently in the right sacro-iliac region and pointing toward Poupert's ligament. The abscess was apparently extraperitoneal. Roentgen rays showed abscess in the right pelvic region, but the sacro-iliac ligaments were sound. This abscess was opened and found to contain streptococci and staphylococci, and the abscess was traced to the right sacro-iliac joint. The patient finally made a complete and permanent recovery.

Extraperitoneal Cesarean Section for Contracted Pelvis.—BRODHEAD (*Am. Jour. Obst.*, March, 1919) chose this method of Cesarean delivery in the case of a stout woman of average height, at full term, who had a large child. He describes the case of a patient with marked toxemia, evidenced by albuminuria and casts; blood-pressure 150, but without headache; visual disturbance and epigastric pain. The pelvis was slightly contracted and the head in the second position was just entering the pelvic brim. Fetal heart sounds were strong and regular, the membrane having ruptured two days before admission. The amniotic liquid was clear and without odor. The temperature on admission was 102.5° , the pulse 128. The patient was carefully watched in the hospital for a twenty-four-hour test of labor. During the twenty-four-hour test of labor the patient was carefully watched; the pulse was rapid, the temperature about 101° F., and at 10 P.M. the patient was tired out, and there had been no progress since 10 A.M. After the

twenty-four-hour test of labor, with rapid pulse and elevation of temperature, the patient was exhausted, without progress, excepting full dilatation. Extraperitoneal Cesarean section was performed; the peritoneum was incised and the parietal peritoneum sutured with the uterine peritoneum for about six inches in the form of an ellipse. When the uterus was opened a foul-smelling, green, amniotic liquid escaped. The child was in good condition, was extracted by the breech and the uterus was packed with iodoform gauze. The patient's pulse was 160 after delivery, but the general condition was fair. The child, a male, weighed nine and one-half pounds. The temperature subsided in four or five days and mother and child made, ultimately, a good recovery.

The Treatment of Eclampsia.—EDGAR (*Jour. Am. Med. Assn.*, No. 70, 1918) describes the value of prenatal care in the prevention of eclampsia. He instances 9 cases of the toxemia of pregnancy admitted to the hospital, with blood-pressure ranging from normal to 228 mm.; 5 were primipara and 4 multipara. All had albuminuria in the urine, 4 had casts and 1 had blood. There were gastric disturbances and edema in all. The mothers recovered, delivery having been effected in various ways. There were 10 children, 1 case being twins. The writer believes that the old principles for the treatment of toxemic convulsions are still sound, namely, (1) control the convulsions; (2) elimination of toxins; (3) termination of pregnancy. The writer states that he has come to consider the use of morphin as the most valuable agent. He believes in the conservative treatment, but would not deny the value of operation in selected cases. A single low forceps operation is always permissible and ether is the only anesthetic which should be employed with these patients. All forcible dilatation or prolonged manipulation should be avoided. Hydrostatic bags to induce a shortened labor may be employed in which the obstacles to dilatation are not insurmountable. It is sometimes necessary to complete dilatation of the cervix by the hand to permit delivery by forceps. In the case of a primipara with long, undilated cervix abdominal Cesarean section is indicated. In the present stage of obstetric science it is interesting to observe that the poor are receiving more intelligent treatment than many who are well-to-do.

An Interesting Mole.—BERRI (*Semaine med.*, No. 25, 1918; *Surg., Gynec. and Obst.*, September, 1918) records the case of a patient, aged forty years, with a history of 9 previous pregnancies, 6 ending normally at term and 3 in abortion. The patient gave a 4 plus Wassermann reaction. In the present illness there was amenorrhea for six months and metrorrhagia since the fourth month of pregnancy. When admitted to the hospital the patient was seven months advanced. On coming to the hospital the woman aborted a discharged ovum corresponding in size and aspect to that of a three months' pregnancy. Careful examination of the specimen failed to discover a fetus or any vestiges of one. The embryo had perished in the early months and had been absorbed. The tissue discharged had the characteristics corresponding to the tuberos hematoma described by Breus. The placenta was retained a long time in the uterine cavity and showed structural alterations, due to autolytic processes.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA,

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Injection of Air in Bladder Diagnosis.—The examination of the bladder for tumors by the expert cystoscopist has been so successful that this modified roentgen method has probably not been developed to the fullest extent according to PFAHLER (*Am. Jour. Roentgenology*, 1919, vi, 371), but there are many cases in which an examination by the cystoscopist is not practical because of pain, inability to pass the instrument, hemorrhage or objection on the part of the patient. The technique that Pfahler follows is to make an anterior and a posterior plate before the injection of air in order to demonstrate the conditions present independent of the air injection. In this way one is able to localize the air or gases which may be retained in the rectum or pelvic colon. The urethral orifice is then cleansed in the usual manner and the largest catheter that is comfortable is passed into the bladder. An atomizer bulb is then attached to a glass connecting tube which in turn is connected to the catheter. After the bladder is emptied, it is distended with air by means of the atomizer bulb until the patient complains of discomfort. The catheter is then clamped and the pictures are taken, usually making one or more exposures posteriorly and the same number anteriorly. After the exposures have been made, the clamp is removed from the catheter and the air is allowed to flow from the bladder. Gentle pressure should be made in the suprapubic region in order to force all of the air from the bladder. Pfahler has never had any bad results from this method and he has frequently succeeded in demonstrating newgrowths in the bladder as small as a thimble.

Neo-Insertion of the Round Ligaments.—Every year brings forth its quota of round ligament operations for the purpose of suspending the uterus, many of which differ very slightly from methods already described. NICHOLSON (*Surg., Gynec. and Obst.*, 1919, xxiv, 194), of Buenos Ayres, now desires to bring to the attention of foreign surgeons the operation of "neo-insertion of the round ligaments" as perfected by Caballero which has given very satisfactory results in 1233 operations. It is employed only to correct fixed or irreducible retrodisplacements or in those cases in which some other abdominal condition, such as disease of the adnexa or appendix has made necessary a laparotomy, since in easily reduced retroversions he always employs the Alexander operation. The essential point in technique which the author describes is the making of a musculo-aponeurotic canal through which

the round ligament is drawn and then anchored to the rectus sheath. With a pair of Kocher forceps, the round ligament is seized about two inches from its uterine insertion, and another pair of Kocher forceps is introduced into the inferior portion of the wound, between the rectus muscle and its aponeurosis as far as the outer border of the rectal sheath and then is plunged through the sheath and peritoneum, entering the peritoneal cavity. This perforation occurs very near the internal orifice of the inguinal canal. The forceps are then opened and the round ligament is seized at the point where it was originally grasped by the first forceps. The forceps is then withdrawn bringing the round ligament with it and the ligament is sutured to the aponeurosis of the rectus about 5 millimeters from its border. The same procedure is performed on the opposite side and the abdomen is closed. This operation is very similar to the method of Simpson which is extensively practised in this country and the reviewer feels that Simpson's method is superior in that it is entirely extraperitoneal. The great argument against this type of operation is the possibility of injury to the deep epigastric artery but the author states that he cannot imagine how an artery the size of the epigastric could be injured by a blunt-pointed instrument. Up to the present time he does not know of a case of retrodisplacement that has recurred after this operation and he has had the opportunity of observing many patients who have been operated upon and who have become pregnant many times, the pregnancies terminating in normal labors. Among his cases there were several that were operated upon during the first few months of pregnancy and with one or two exceptions, the pregnancy has gone on to term and labor has been normal.

Bloodless Hysterectomy.—In order to overcome any possibility of secondary hemorrhage following the removal of the fundus uteri, VAN HOOSSEN (*Surg., Gynec. and Obst.*, 1919, xxix, 196) has elaborated a technique whereby a bloodless hysterectomy may be performed. After the abdomen has been opened, the fundus of the uterus is grasped with a volsellum forceps and lifted well into the incision, or as high as possible. The assistant now maintains traction on the uterus while the operator places the index finger of the left hand under the round ligament and the thumb of the same hand under the ovarian ligament, at the same time retracting the broad ligament from the body of the uterus. With the right hand an 8-inch forceps (preferably of the angiotribe pattern) is placed on the body of the uterus from a point opposite the internal os to the tubal attachment and the forceps is closed slowly enough to allow the uterine musculature to slip to the inner side. The forceps is closed lightly without using the racquet. Another forceps is placed in similar manner internal to this and touching it throughout its length. The side opposite is treated in the same way. By this application of forceps the uterine artery and the uteroövarian anastomosis are pushed away from the body of the uterus and the peritoneum covering the uterus is rendered tense. The peritoneum over the uterus on both anterior and posterior surfaces is now incised, beginning one-half inch above the line where the peritoneum is intimately connected with the uterus and extending upward on each side parallel with the forceps and one-half inch internal to it. The peritoneum adjacent to the forceps on both the anterior and posterior surfaces is lifted by undercutting with a sharp knife. Strong traction is now made in turn

between the volsellum controlling and holding the body of the uterus and the forceps applied on each side and with a few strokes of the knife the uterine musculature is separated from the parametrium and the uterus is freed down to the internal os. With dissecting scissors the cervical musculature and mucosa is coned out for any distance, even to the external os if so desired, and lifted out with the attached body of the uterus. Neither ovarian nor uterine artery having been severed, the suturing may now be begun. The first suture is placed deeply uniting the anterior and posterior border of the cervical cone. The internal forceps on the edge of the severed broad ligaments are now removed and the remaining forceps are drawn together and held until the cut edges on each side can be united to each other with a lock stitch. The lateral edges are united first from the posterior surface and after removal of the remaining forceps from the anterior surface. If a generous border of peritoneum has been left there will be no surface uncovered by peritoneum except possibly at the tubal location. This can be better covered and at the same time the stump which represents a skeleton uterus can be elevated by passing a suture through each round ligament about one inch from the uterine attachment and by tying them together over the uterine skeleton and fixing them thereto. If the tubes are to be removed, an 8-inch angiotribe or strong forceps is placed on the broad ligament above the ovary and close to the tube and the tube is peeled out of its peritoneal covering and the cut edge of the peritoneum is ligated *en masse*, but not including the ovarian artery.

Stricture of the Ureter.—For several years HUNNER (*Southern Med. Jour.*, 1919, xii, 396) has devoted considerable time to the study of stricture of the ureter and his publications have been of much interest and value. In the study of about 500 cases of ureteral stricture occurring in his practice during the past four years he has arrived at a number of important conclusions. Some of these are startling because of their newness but none of them would have been presented had he not had full confidence that time and further investigation on the part of other men would give them support and verification. He believes that ureteral stricture is one of the commonest causes of abdominal symptoms in women. Unrecognized ureteral stricture leads to more needless and fruitless abdominal operations than any other pathological condition. These operations in the probable order of frequency are for appendicitis, ovarian disease, uterine and pelvic disorders, floating kidney, especially the type with hydronephrosis, gall-bladder investigations, and abdominal explorations for intestinal obstruction and adhesions. Ureteral stricture, according to Hunner, is the cause of more kidney pathology (excluding conditions usually classified as medical) than any one factor. It accounts for the majority of hydronephrosis cases, and thus indirectly for many cases of floating kidney and of pyonephrosis. The majority of pyelitis cases have ureteral stricture and obstruction as a basis. Most cases of pyelitis of pregnancy and of the puerperium depend upon stricture, as do many cases of pyelitis in children. Some cases of albuminuria and eclampsia leading to premature childbirth are due to stricture. Most cases of stone in the ureter and probably many cases of stone found in the kidney and bladder arise in an area of ureteral stricture. It is probable that urinary stasis due to stricture is the predisposing factor in many cases of stone arising in the kidney and of recurring

kidney stone after operation. Many, if not the majority of cases of so-called essential or idiopathic hematuria are due to ureteral stricture. Finally, Hunner states that time and experience have amply verified his original theory that most cases of ureteral stricture and many cases of chronic urethritis are due to focal infections. In order to arrive at an accurate diagnosis of this condition, a careful history must be taken in every case and this must be followed by a most painstaking physical examination. The urine analysis is then closely studied after which the newer methods of diagnosis are employed including roentgenography, cystoscopy and ureteral catheterization especially with the wax bulbed catheter.

Indications for Operation in Ureteral Calculi.—The discussion of the question whether or not to operate upon a case of ureteral calculus was a much easier task ten years ago than at the present time. This change in viewpoint is in great measure due to the rapid development of the non-operative methods of treatment, with which every surgeon should not only be familiar but give his patient the benefit of, before operation is considered. As a result of a rather extensive experience in renal surgery, EISENDRATH (*Ann. Surg.*, 1919, lxx, 192) has formulated some very helpful rules in determining the indications for operation. He believes that operation is indicated when colics recur or infection persists after repeated attempts have been made to deliver the calculus by non-operative methods and there is practically no change in the location of the calculus; also when there are evidences of stricture formation following (a) the spontaneous expulsion of a calculus, (b) or its delivery by non-operative methods, or (c) after a ureterotomy, or when a fistula is present either (a) as the result of perforation of the ureteral wall by a migrating calculus, or (b) above a stricture. Operation is certainly indicated when a severe degree of renal infection is present and the calculus is impacted in the ureter. Whether or not it is necessary to remove the kidney in addition to the ureterotomy depends on the degree of involvement of the renal pelvis and parenchyma. Some of these cases are complicated by a peri-ureteral or perinephritic abscess which will require immediate drainage. Calculous anuria cases should be operated upon as soon as the diagnosis of the location has been made. The average period of tolerance is six days. If the calculus is located near the vesical end of the ureter an attempt to deliver the calculus by manipulation is worthy of a single trial, but one should not lose valuable time by postponing operative interference too long while such an attempt is being made. In cases of either aseptic or infected hydronephrosis immediate operation is indicated. As a rule, the degree of dilatation of the renal pelvis is such that a nephrectomy is necessary. If pyelography can be done in such cases, it gives the best picture of the extent of the destruction of the parenchyma. Many of the cases in which an attempt has been made to save the kidney may be benefited by catheter drainage or renal pelvic lavage. Bilateral ureteral calculi alone without concomitant renal calculi occur so infrequently that it is best to consider the two together and in such cases the kidney with the acute complications should be operated on first. In cases where no complications are present, the kidney with the better function should be operated upon first although occasionally simultaneous bilateral operation is advisable.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

OSKAR KLOTZ, M.D., C.M.,

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

Studies on Compensatory Hypertrophy of the Thyroid Gland.—The definition of conditions under which compensatory hypertrophy of the thyroid gland may be expected to occur, has been uncertain. LOEB (*Jour. Med. Res.*, 1919, xl, 199) presents his work on guinea-pigs. A particular description of the thyroid gland of guinea-pigs notes the normal variations in microscopic structure. Slight changes, indicating the beginning of hyperplasia are noted to occur following extirpation of one lobe, the removal of one-half lobe producing no demonstrable change. Definite hypertrophic changes were found after the extirpation of one lobe and about one-half to two-thirds of the other lobe. These changes were more marked after almost complete extirpation of both lobes; consisting of hypertrophy of the epithelial cells, diminution in colloid content with accompanying deformation of acini and an increase in the number of mitoses. The hypertrophy is apparently independent of age and only slightly influenced by general nutrition. In a majority of cases the hypertrophic changes occurred between the fifteenth and eighteenth days following operation and persisted for six to eight weeks. Pregnancy may occur after almost complete extirpation of both thyroids. In the major portion of cases abortion followed an almost complete extirpation of thyroid in the pregnant guinea-pig. Pregnancy does not usually interfere with the occurrence of compensatory hypertrophy. It may exert a slight inhibitory influence.

Microörganisms Found in Canned Foods.—The preservation of food by canning has been of interest from the medical bacteriological standpoint, because of the possibility of contamination by pathogenic organisms in such processes. CHENEY (*Jour. Med. Res.*, 1919, xl, 177) gives results of his work in the determination of whether viable organisms persist in apparently tight cans of merchantable foods, after modern sterilizing methods. The ordinary sources of contamination of foods before canning and the factors involved in spoilage of canned foods are reviewed. A brief survey is given of previous work on the problem directing attention to the types of organisms (principally non-pathogenic spore-bearers), previously found. There follows a detailed technic of obtaining cultures from the cans and their contents, and of the media used for identification of molds and yeasts, aërobes, anaërobes, gas forming and thermophilic bacteria. The percentage of cans containing living organisms in each kind of food was remarkably constant. The contamination seems to be in inverse proportion to the efficiency of the sterilization. A rather sharply limited group of

organisms was isolated, involving forms producing resistant spores, including the *B. subtilis*, mesentericus group, the related thermophiles, and one anaërobe. In addition four common species each of *aspergillus* and *penicillium* and two borderline yeasts were demonstrated. Seven hundred and twenty-five cases of merchantable food were examined for bacteria molds and yeasts. Eight per cent. of these cans were found to contain viable organisms, none of which were pathogenic. Vegetables constituted 8 per cent. of cans showing viable organisms, fruits 3 per cent., fish and meats 10 to 20 per cent. The contamination in fruits is principally moulds and in fish and meats bacteria.

Types of Streptococci Found in the Sputum of Bronchial Asthmatics.
—WALKER and ATKINSON (*Jour. Med. Res.*, 1919, xl, 229) present the results of a study of fifty cases of bronchial asthma. Particular attention is given to the occurrence of streptococci which are typed according to Holman's classification, which they found a practical one. The technic of culturing and identifying the various strains is given in detail. Hemolytic streptococci were recovered from the sputum of 46 out of fifty patients, subacidus, anginosus, pyogenes and infrequens being the principal strains isolated. It is suggested that the protein of these four strains be used, in cutaneous tests on asthmatic patients. Evidence was offered that all of the types of hemolytic streptococci which were isolated, might become pathogenic. Of the non-hemolytic streptococci, non-hemolyticus I, ignavus, salivarius and mitis were most frequently isolated. The results of treatment of the fifty patients with autogenous sputum vaccines, consisting of the predominating organism are given. It is suggested that autogenous sputum vaccines be made at frequent intervals, because of the variation in the predominating organism. The washed sputum was found to be fairly free of mouth contamination and contained only eight distinct kinds of bacteria other than streptococci.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

MILTON J. ROSENAU, M.D.,

PROFESSOR OF PREVENTIVE MEDICINE AND HYGIENE, HARVARD MEDICAL SCHOOL,
BOSTON, MASSACHUSETTS,

AND

GEORGE W. MCCOY, M.D.,

DIRECTOR OF HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE,
WASHINGTON, D. C.

Mental Deficiency of Prostitutes.—MERTZ (*Jour. Am. Med. Assn.*, 1919, lxxii, 1597) sums up the outstanding facts in the mental aspects of prostitution as found in Newport News as follows: (1) 53 per cent. of the women arrested for prostitution and kindred offences and held in the detention home for examination had a mental age

of ten or under; (2) in addition, 15 per cent. of those who were not mentally deficient showed mental disorder; (3) 10 per cent. were so deficient as to warrant, under existing laws, segregation in an institution for the feeble-minded; (4) 50 per cent. of these women did not reach the fifth grade in school; (5) if seeking for a "type," the composite of the delinquent woman as found in Newport News would seem to be a woman of nineteen, slightly mentally deficient, with schooling to the fourth grade.

The Effect of Freezing upon the Organisms of Typhoid Fever and Diphtheria.—An outbreak of diphtheria and one of typhoid fever which had been epidemiologically studied by officers of the United States Public Health Service, and seemed properly attributable to the ingestion of polluted ice-cream, prompted BOLTON (*Pub. Health Rep.*, February 8, 1918) to institute experiments to determine how long the typhoid bacillus and the diphtheria bacterium could survive freezing and whether freezing had any influence upon the pathogenicity of the latter organism. To determine the resistance to freezing of the typhoid bacillus, he planted four metal containers of pasteurized cream, each with 5 c.c. of a twenty-four-hour broth culture of *Bacillus typhosus* (Rawling's), froze them in a brine tank and on each successive day for about a month, and on every alternate day for about another month, melted and refroze them after streaking a loopful from each container across an Endo plate. During the first few days there was very little change in the number of colonies per plate, but after ten days to two weeks only about half the number were counted as compared with the original plate counts. At the end of the month the colonies developed were very few, about one-twentieth of the number on the original plates. Finally the containers were kept frozen continuously for eighteen days and again tested. In two of the containers the cultures were apparently killed, since no growth was obtained on the Endo plates; the other two containers continued to show slight growth, one colony per loop from one and six from the other. To study the effect of freezing upon the viability and toxin production of *Bacterium diphtheriæ*, eight pure cultures, isolated from clinical cases during the epidemic, were used. Two small Loeffler slant tubes were planted respectively with each culture and incubated for twenty-four hours at 37° C. One of these was harvested with 5 c.c. of salt solution and added to 40 c.c. of pasteurized cream. These cultures were frozen for four days, when subcultures were made in 2 per cent. neutral peptone from the frozen cultures and the unfrozen controls. The subcultures were incubated for five days at 37° C. On the fifth day guinea-pigs were inoculated with 1 c.c. of each of the broth cultures, eight pigs for the frozen and eight pigs for the unfrozen cultures. On the basis of this experimental work the conclusion was drawn that ice-cream may be regarded as a possible agent in the distribution of typhoid fever and diphtheria.

Detection of *Bacillus Tetani* in Vaccine Virus.—The appearance of a number of cases of tetanus in a community following a more or less general vaccination against smallpox raised the suspicion of tetanus contamination of the vaccine virus used, and made necessary an attempt to determine the source of contamination. McCoy and

BENGSTON (*Hyg. Lab. Bull.*, No. 115) report the results of a systematic bacteriological investigation and emphasize the salient facts established. From the history of the cases of developed tetanus it was shown that the vaccinations against smallpox had been practised exclusively with ivory points from a single manufacturer. After taking administrative action to prevent further distribution of the suspected vaccine material and to effect the recall of that already on the market the investigation was begun. First, uncharged ivory points, just as they were received from the manufacturer of ivory points by the manufacturer of the vaccine, were examined by planting them under anaërobic conditions, with the result that tetanus-like organisms developed in some of these cultures and animal inoculations (guinea-pigs and mice) with the contents of these tubes demonstrated the presence of tetanus spores on uncharged ivory points. The next step was to determine if this tetanus contamination is common with the ivory point of other manufacturers. The ivory points of three different manufacturers were tested in the same way, with the result that tetanus organisms were detected on the points furnished by two establishments. It is the practice of the manufacturers of vaccine points to "sterilize" the ivory points before charging them with the vaccine material. A large number of ivory points that had been "sterilized" and made ready for charging with vaccine material by the manufacturer whose vaccine points were under suspicion were examined, with the result that tetanus spores were detected in several. Tests were made of fourteen different laboratory numbers of packages of vaccine points from the manufacturer under suspicion, with the result that in four flasks, all of which had been planted with points of the same laboratory number, tetanus organisms were detected by mice inoculation. Capillary tubes of vaccine virus of the same suspected manufacturer showed no growths. The same negative results were obtained with plantings of glycerinated lymph and bulk vaccine of this manufacturer. Supplemental experimental work was carried out to determine the conditions most favorable for the growth of *Bacillus tetani* and the formation of tetanus toxin in contaminated vaccine virus.

The Physician's Responsibility in Diphtheria.—In a study of 1000 deaths from diphtheria made by Dr. B. W. CAREY, of the Massachusetts State Department of Health (*Boston Med. and Surg. Jour.*, January 16, 1919), evidence is presented which shows that for various reasons the abundant fund of useful knowledge which medical science has at its disposal for dealing with diphtheria is still utilized far too little. Especially discouraging, after the many years of exhortation to call a doctor at once, is the fact that in over 23 per cent. of the cases the patients had been ill a week before the physician was called. In 4.2 per cent. the patients had been ill from one to two weeks before they received medical attention. It is also surprising to find that in a populous State like Massachusetts, where laboratory facilities as well as antitoxin and Schick outfits are conveniently available, 7.6 per cent. of the deaths should have occurred in "unrecognized" cases. Apparently this denotes carelessness on the part of the medical profession. It is certain, as the Massachusetts State Health authorities point out, that health authorities have a right to expect that the diagnostic and therapeutic facilities which they furnish be utilized by the practising physicians to

effect a diminution of the morbidity and mortality of diphtheria. Inquiries as to the dosage and use of diphtheria antitoxin also indicated that physicians were not utilizing this remedy in accordance with the best experience. In a number of fatal cases studied the physician had delayed antitoxin treatment by waiting for a laboratory confirmation of the diagnosis. In not a single instance was the antitoxin given intravenously, and this despite the fact that in several cases antitoxin was administered every four hours until death occurred, in one instance a total of 80,000 units being given this way. That the complaint of the Massachusetts State health authorities is not only well justified, but that it probably voices a legitimate indictment of a part of the medical profession generally, is indicated by the fact that a very similar complaint was made by the New York City health authorities a year or two ago. With a diagnostic laboratory service unsurpassed, and with Schick test outfits, antitoxin serum, and active immunization outfits practically at their elbow, the physicians of New York were charged with insufficient or delayed utilization of these aids and with responsibility in the continued prevalence of fatal cases of diphtheria. It is possible that a thorough investigation of every fatal case of diphtheria, with a request for an explanation by the attending physician, might serve to make those who are now negligent in their management of cases of diphtheria exercise greater care and thus lead to a saving of life.

Preliminary Report on Carbon Tetrachloride Vapor as a Delousing Agent.—FOSTER (*U. S. Public Health Reports*, October 25, 1918, states that the effectiveness of dry and moist heat and hydrocyanic acid gas as a means of destroying body lice on clothing has been thoroughly investigated. These processes, while effective, require the use of a somewhat complicated apparatus which is not easily transported and not always available for troops in actual warfare. Also in civilian life the problem of cleaning up lousy clothing without special appliances occasionally presents itself in jails, small hospitals, asylums, camps and even the home. In the search for some practical method of destroying lice which could be applied with simple apparatus and which would not injure woollen fabrics the writer was led to investigate the effects of carbon tetrachloride vapor. The vapor of carbon tetrachloride was contrasted with that of gasoline and chloroform in regard to its effect on flies and was found to be much more toxic to these insects than either of the other two. The pure vapor killed unprotected lice in fifteen minutes but failed to destroy them in ten minutes. The following method was thoroughly tested: A 10-gallon tin can, such as is used for shipping liquid disinfectants, was obtained. The top was cut out so that clothing could be introduced and removed readily. The complete outfit of wearing apparel was placed in the tin and pressed down rather firmly, occupying a little more than one-half of the total space. Several layers of filter paper were laid on top of the clothing, and on this paper 25 c.c. of carbon tetrachloride was poured. The top of the can was covered by several thicknesses of towelling and a loose cover placed over this, the idea being to protect the can from the effects of drafts but not to seal it hermetically, so as to permit some of the air to escape at the top when it was displaced at the bottom by the heavy vapor. At the end of two hours the can was opened and the package containing

the lice-infested shirt was aired and examined. All the lice were found to be dead, and they did not revive when examined at various periods up to twenty-four hours afterward. It was ascertained that exposure, under similar conditions, to the same strength of carbon tetrachloride for an hour and a half was not sufficient to kill all the lice, about 25 per cent. surviving. It was also found that a lesser amount of carbon tetrachloride was not sufficient to kill the lice in two hours. These experiments were repeated in various ways with lice, on pieces of cloth contained in test-tubes at both ends, but fairly tightly sealed with cotton plugs. These tubes were tightly wrapped in all the various articles of clothing, and it was found that 25 c.c. of carbon tetrachloride, with exposure of two hours, was sufficient to kill all the lice. The garments were hung up and aired for an hour, after which no odor of carbon tetrachloride could be detected on them. The fact that carbon tetrachloride is the base of one of the widely advertised cleaning fluids for removing grease spots from clothing would seem to indicate that its use in the hands of the laity is not accompanied by any grave danger. It is not contemplated to propose it as a substitute for the heat of cyanide gas treatments where these are available, as they would certainly be much more economical where large bodies of men are to be deloused at one time and in one place.

Disabling Sickness in Relation to Family Income.—SYDENSTRUCKER, WHEELER and GOLDBERGER (*Public Health Reports*, November 28, 1918), state that the experience derived from the census of sickness and from the records of working days lost on account of sickness in the seven cotton mill villages studied appears to suggest the following: A higher sickness (involving inability to work) rate and a greater amount of working time lost on account of such sickness were found among members of families whose incomes were at a low status. This condition appeared for persons of either sex and of similar ages. Only when a family income approximated \$10 per half month per adult male unit (or about \$900 a year for a family of "normal" size in 1916) did the sickness rate appear to be as low as that suggested by similar censuses in a number of localities in the United States as the normal rate. Low economic status appeared to be a more striking concomitant of high sickness rate among females than employment in mill work. A greater proportion of disabling illness, of relatively long duration, appeared among persons whose family income was below the average than among persons with a more favorable economic status. To what extent low family income was a cause of higher sickness rate and to what extent it was an effect of disability (and thus of inability to increase income) cannot be determined. The condition, however, is manifest that a greater amount of disabling sickness existed among persons who were living under less favorable economic conditions than among persons whose economic status was more favorable—a condition which has been pointed out by previous observations in literature on the social aspects of ill health and indicated by several recent studies. The data here presented afford additional ground for the suggestion that in the analysis of morbidity facts the factor of economic status should be given proper emphasis.

Typhoid Fever and Municipal Administration.—FREEMAN (*Public Health Reports*, 1918, xxxii, 643) presents a study of the means of typhoid fever prevention employed in its relation to the prevalence of the disease in a group of cities in the Ohio River Valley. The conclusions drawn from a study of the means employed are strikingly borne out by the prevalence of typhoid fever in the group of cities included. The major factors in typhoid fever causation—polluted water and improper disposal of human excreta—are still largely operative. The minor factors, with the exception of the pasteurization of milk, are largely ignored. The group of cities, fairly representative of a very large class of American municipalities, still suffers from an excessive prevalence of typhoid fever, due to well-understood and easily preventable causes.

Trinitrotoluene Poisoning.—An extensive investigation of trinitrotoluene poisoning by VOEGTLIN, HOOPER and JOHNSON (*Public Health Reports*, 1919, xxxiv, 1307) gave results which may be summarized as follows: A great difference in susceptibility of various animals was found; dogs (and probably men) are much more susceptible than are white rats, guinea-pigs and rabbits. The symptoms in dogs are cyanosis, diarrhea, salivation, incoördination, icterus and anemia, sometimes with loss of weight. The chemical is absorbed through the skin, through the gastrointestinal, the respiratory tract and from the subcutaneous tissue. The urine shows a positive Webster test early, but the reaction is not due to T. N. T. but to a metabolic product of the latter. The feces never give this test. The minimum toxic dose is less than 5 mg. per kilo and no tolerance is established. The highly purified T. N. T. is just as poisonous as is the commercial product—in other words, the poisoning is not due to impurities of the product. In chronic cases anemia of varying intensity develops. A varnish made of shellac, castor oil and alcohol is suggested for application to the hands and the forearms as a prophylactic agent, and cotton gloves impregnated with a modification of this varnish are also suggested. Sodium hydrosulphite and sodium sulphite are excellent solutions for removing the poison from the skin. It is recommended that a fall of hemoglobin of 15 per cent. to 20 per cent. be regarded as an indication for taking an individual off work which exposes him to T. N. T., and the appearance of bile pigments in the urine should be dealt with in the same way. A generous diet, particularly one rich in meat, the elimination of susceptible workers, free ventilation of factories, and the use of the gloves or varnish are the chief means of dealing with T. N. T. industrial poisoning.

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DR. GEORGE MORRIS PIERSOL, 1913 Spruce St., Philadelphia, Pa., U.S.A.

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ORIGINAL ARTICLES

THE MEDICAL ASPECTS OF RECONSTRUCTION.

BY W. S. THAYER, M.D., HON. F.R.C.P.I.,

LATE BRIG.-GEN'L, M. C., U. S. A., BALTIMORE, MARYLAND.

IN the ordinary practice of medicine, apart from the fundamental question of diagnosis, the doctor finds himself mainly concerned with the closely interwoven problems of the prophylaxis and treatment of disease. The war has emphasized the importance of that other duty of the physician which is so difficult often to fulfil, namely, the care of convalescence—that part of medicine which may more properly be regarded as “reconstruction.”

When the acute symptoms of a disease have passed, when convalescence is well established, the activities of the physician too often come to an end. In private practice the doctor, sensitive lest he may seem unnecessarily to obtrude his services on the patient, who no longer needs immediate supervision because of the emergencies of the disease, makes his adieu with an earnest recommendation that the invalid take a suitable vacation, advice which the latter rarely feels justified in following.

In hospitals the demand for space requires that the patient be discharged so soon as he is comfortably on his feet. A few fortunate institutions are able to offer to a limited number of patients the advantages of a “convalescent home,” which affords rest and good food for perhaps two weeks. In general, however, with the discharge of the doctor in private practice, or of the patient in hospital, the duties and responsibilities of the physician as regards that particular individual are considered to be at an end. The conduct of his convalescence is left to the patient, who is now his own master.

In war, conditions are different. The patient is not his own master; he is the servant of his country and his master needs his services as quickly as they may be available. These services are, however, useful only when the subject is restored to complete efficiency and able to perform his duties to the full. The conditions of service in France were such that every man who could be returned to the line and every man who could be useful at the base was needed at the earliest moment; on the other hand, it was equally desirable that every man who was not fit for service be returned to America with the least possible delay. Thus it was that the exigencies of war soon brought it about that the study and care of convalescence became one of the most vital and important of medical questions.

In other words, in war time in France the value of the care of convalescence, of medical reconstruction in its narrow sense, came to take its proper place in the practice of medicine.

It is not alone to the period after discharge of the patient from the hospital that the term "reconstruction" may be applied. To think of reconstruction as applicable alone to the treatment of those convalescent from a grave wound or malady is an idea as mistaken as to think of prophylaxis as associated only with measures of general sanitary preparation, such as one may adopt before the occupation of a camp site, or to think of treatment as of necessity associated with the wards of a general hospital. In reality the problems of reconstruction are so closely interwoven with questions of prophylaxis and of treatment, that in private practice, as well as in war time, they form an indivisible trinity.

The individuals with whose rapid and efficient rehabilitation we were concerned may briefly be classified as follows:

1. Those numerous instances of exhaustion, concussion, and especially of fear, anxiety neuroses and psychoneuroses of all sorts, which, if not arrested at an early period, so easily pass down the line of communications and under the influence of the surroundings of a general hospital become "fixed."

2. The mildly gassed, who are especially liable, if not properly cared for, to present annoying psychoneurotic phenomena.

3. Those psychoneuroses of a more serious character which need longer treatment and care at a base hospital.

4. Convalescents from all types of non-disabling wounds, gas intoxication, operations and disease.

5. Patients suffering from that complex of symptoms known in the A. E. F. as an "effort syndrome," a group which includes many of the convalescent gassed.

6. The tuberculous.

It was soon found that in the confusion of battle and the necessity of rapid evacuation a large number of men suffering from simple exhaustion, fear, concussion and a variety of lesser functional

nervous phenomena, and often incorrectly classed among the gassed, passed back into base hospitals, far distant from their original station. The same was true of many of the mildly gassed. Some of these men recovered quickly after a few days' rest. Many were clamorous to return to the front. Some were quite ignorant as to why they had been sent back. These men, who before returning to their organizations were obliged to go to a depot division, were permanently separated from their original assignments. Lying about hospitals they rapidly lost morale, discipline and physical vigor, and on their arrival at a depot division were soft in every way. In others of a more impressionable character, ill-judged treatment in a general hospital resulted in the fixing of psychoneuroses which, once established, were difficult to overcome. It became clear early that measures must be taken to hold these men so near the front as possible at some point where they might be given rest, suitable treatment and study. This was the main problem of reconstruction at the front.

At the base the problems were almost equally urgent. The ordinary disability board in the crowded hospital, obliged to pass upon the soldier as he is hurriedly evacuated, can make but an imperfect and superficial prognosis as to the future capabilities of the given individual, an estimate often changed over and over again as the convalescent passes from hospital to hospital on his way toward the rear. During the often long periods of physical inactivity the patient's muscles become relaxed and his morale depressed, and soldiers frequently required considerable periods of retraining before they were able to take up their functions. With others it was only through the discovery by actual test at the front and failure satisfactorily to perform the duty assigned to them that men found gradually their proper level. This meant a material loss of time. It became evident that those men who, on discharge from the hospital of the first instance, were regarded as fit for some duty in France must be sent directly to some spot where they might receive such treatment and training as would prepare them at the earliest possible moment for the special functions which they might have to fulfil. This was the main problem of rehabilitation as it related to the base.

1. PROBLEMS OF RECONSTRUCTION IN DIVISIONAL, CORPS AND ARMY AREAS. The first desideratum, as has been said, was that instances of exhaustion, fear, the mildly gassed and psychoneuroses be held for a few days at field hospitals or at divisional or corps rest or retraining camps. That a proper selection of suitable cases be made demands the presence of well-trained medical officers at the "*triages*"—advanced field hospitals—that which, unfortunately, was not always possible in the organization that we possessed in France. Excellent results, however, followed the stationing at these points, at the suggestion of Col. Salmon, of trained neuro-

psychiatrists. Here many instances of simple exhaustion or fear or concussion, which previously had been sent to the rear, perhaps as gassed, were held, suitably treated and returned to their organizations after two or three days' rest. Under favorable circumstances it was found that as many as 80 per cent. were returned to their divisions—the average during the Argonne offensive was 65 per cent.

But in times of special stress such measures were not possible at crowded field hospitals in corps and divisional areas. The wise measure was accordingly adopted of establishing in the army area special so-called neurological hospitals and special gas hospitals. The neurological hospitals were under the general supervision of Col. T. W. Salmon, senior consultant in neuropsychiatry, the army psychiatrist and a carefully selected staff. To Col. Salmon's foresight, good judgment and efficiency as director and senior consultant in neuropsychiatry our army owes much.

In the Argonne the gas hospitals were placed temporarily under the professional supervision of Lieut.-Col. Richard Dexter, senior consultant in medicine for gas. Between these two groups of hospitals the mildly gassed and the instances of exhaustion, fear and other lesser psychoneuroses were differentiated, and suitable treatment, mental and physical, was afforded to all.

From the neurological hospitals an average of 58 to 60 per cent. were returned to the front. From the gas hospitals many of the simply exhausted were also sent directly to such corps as had established a rest camp or replacement depot, and thereby saved to their original organization; others passed to the rear and were distributed in various base hospitals. The early and proper treatment of the gassed resulted in a material shortening of the period in hospital, and hastened their return to active service.

While the desirability of the designation of special base centres or hospitals for the care of the gassed was recognized, the difficulties of evacuation were such that their establishment had not become possible at the time of the armistice.

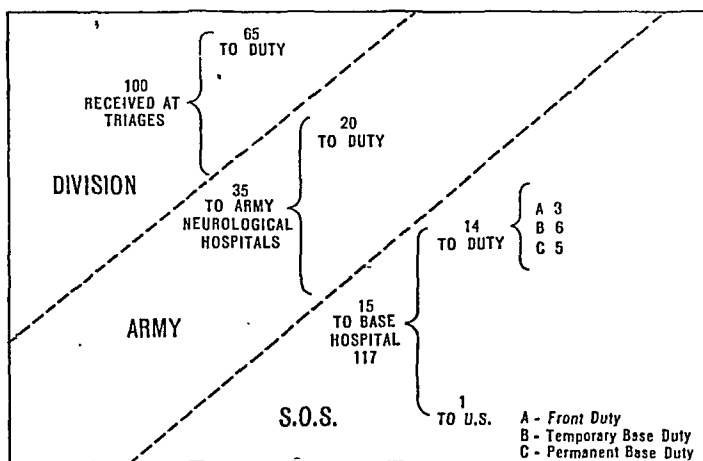
2. PROBLEMS OF RECONSTRUCTION AT THE BASE.. In base areas there were established certain institutions which were in a stricter sense reconstruction centres.

(a) *The Neurological Base Hospital (117) at Lafauche.* Thus, at Lafauche, not more than fifty miles from the front, there was a special neurological hospital (117), to which were sent those cases returned from the like hospitals in the army area. Here and in a small adjacent convalescent camp, under the care of a selected staff, over 93 per cent. of these cases were returned to duty—20 per cent. to field duty. Only 7 per cent. of those sent from the front to Base Hospital 117 were returned to America.

The nature and value of this institution, Col. Salmon has discussed elsewhere. To this hospital, which, in extent, was far from adequate to the demands made upon it, psychoneuroses arising elsewhere in the A. E. F. were also sent so far as possible.

(b) *The Orthopædic Retraining Centre.* The earliest of the special reconstruction centres was the Orthopædic Retraining Camp established by Dr. Goldthwaite, first in the Vosges and afterward at St. Aignan in Touraine. Here excellent work was done in rehabilitating officers and men whose disabilities were found to depend on various remediable surgical defects, especially on bad shoeing.

(c) *The Convalescent Camps.* To meet the demand for a more rapid and efficient rehabilitation of all convalescents there was planned near each group of base hospitals, a special camp, in which it was hoped that convalescents might receive carefully devised physical and mental training, associated with skilled supervision, which, on the one hand, might be directed toward the rapid rehabilitation of the patient and on the other toward the earliest possible recognition of the moment at which he was fit to return to duty.



Into the history of these institutions it is impossible to enter at length. Already at the time of the inception of our hospital system the convalescent camp in the British service had reached a high degree of efficiency. The British experiences and the results which they had achieved were of the greatest value to us. It was, after all, on the British model that we had hoped to build. Suffice it to say that at the outset, designed as an overflow, to relieve the crowded base hospital so soon as might be, they were regarded as commands suitable for older or less capable officers. Soon, however, the value and importance of the work of retraining, the complexity and delicacy of the problems involved, the necessity that the director of such a camp should be possessed of signal tact and judgment and *savoir faire*, brought it about that in the British service the position of commanding officer of a convalescent camp came to be one for which officers of the very highest qualifications were sought.

Our camps were under canvas, and it was desirable that the conditions under which the men should live might be so nearly as

possible those which they might expect under favorable conditions while on active duty. The camp was under the charge of a medical officer. It was not, however, a hospital but a retraining centre. The object to be attained was the most rapid possible preparation of the individual for his return to duty. To accomplish this it was necessary to consider both the mental and the physical aspects of the case. The soldier must be given graded physical training, carefully adapted to his powers; these powers must be tested at frequent intervals. As the individual proved himself able to return to duty he must be sent to the depot camp or reclassified and assigned to that duty for which he was fitted. To accomplish this with the greatest efficiency a carefully designed schedule of work, play and amusement must be arranged. The soldier must, in the first place, be always under military discipline. He must be on a duty status. This he should never be allowed to forget. Periods of drill, setting-up exercises and marches, should be carefully interlarded with other periods of rest, recreation and amusement. The amusements and periods of rest should be so planned that the patient's mind should, so far as possible, always be healthfully occupied. It is often true that men who tire soon at drill, enter enthusiastically into games through which valuable physical training is acquired. Relaxation in the shape of music and theatrical performances, in which the patients take part, should be provided. The programme of the day should be so ordered that the soldier has no idle time, and the schedule of work and play should be one calculated to improve the morale of the camp as a whole. For neurotic individuals, especially those with effort syndrome, the moral aspects of treatment are especially important. With many such the work should be so arranged that at the outset, although under military discipline, the men may not feel themselves driven—that the primary physical demands may not be too great. Such men, started aright, soon find themselves carried along in the general stream, and freed from anxiety and apprehension, they gain with surprising rapidity. The soldier should be observed by medical officers at the end of drills, marches or exercises. So soon as he becomes able without effort to perform the work and play of a given class, he should be passed on to the class above in which the physical demands are greater. The demands for graduation from the last class should be equal to those to which the soldier is subjected on a duty status.

Such, roughly, was our ideal of the convalescent camp. To each of our institutions an officer was assigned who had had special training in cardio-vascular disease and had passed several months at Colchester with Dr. Thomas Lewis—officers carefully selected and supervised by Lieut.-Col. Alfred E. Cohn, senior consultant in cardio-vascular disease, whose excellent conception of the convalescent camp was set forth in lectures before the Army Sanitary School,

To these camps convalescents of all sorts were sent so soon as they might be discharged from hospital. Although, at the period of the armistice, most of our camps were in a crude and undeveloped state, several had demonstrated their value. It had been hoped that a special central laboratory and camp for the study and treatment of effort syndrome might be established at Pougues les eaux, but it was considered better to send the ordinary run of cases of effort syndrome to these camps, and the results, so far as we could judge, were good.

(d) *Measures with Regard to Tuberculosis.* In the early spring of 1918 Col. Bushnell, impressed by the considerable number of instances of so-called pulmonary tuberculosis returning from France, detailed Major, now Lieut.-Col. Webb, to investigate the matter. Col. Webb found that out of one hundred cases arriving at an American port with the diagnosis of tuberculosis, only about 30 per cent. presented manifestations justifying the diagnosis. On arriving in France and studying the conditions at a base port where patients were being gathered for deportation, similar conditions were found. This was due largely to (a) a lack of proper knowledge of physical diagnosis or a lack of attention on the part of the officers in charge, or (b) to the habit of accepting the interpretation of a Roentgen-ray plate by a radiologist as evidence of active tuberculosis. Systematic instruction in the diagnosis of tuberculosis was given by Lieut.-Col. Webb in many of the base hospitals; furthermore, arrangements were made by which all cases in which tuberculosis was suspected without the demonstration of bacilli in the sputa were referred to special collecting centres in which arrangements for their proper study were afforded. In two of these centres near base ports special arrangements for the detention and care of the tuberculous who needed rehabilitation before deportation were provided.

These in a general way were the measures of medical reconstruction adopted in France.

The experience gained in the British convalescent camps and in one of our incomplete and mushroom-like organizations has given us some results on which it is worth dwelling. At one of the earliest of these formations, convalescent camp No. 2 at Lifol le Grand, Capt. Bridgman was able to make some interesting observations. Here careful physical examinations of the patients were made by competent officers on entrance and before discharge, and a "follow-up" system was established which was designed to obtain replies from battalion medical officers two months after the return of the soldier to his organization and again in six months. Out of the first 5000 cases replies after two months were received in 2000, from which it became apparent that outside of the killed and wounded, over 99 per cent. of those returned to duty as Class A men were performing their normal functions—a significant evidence of the value of a well-ordered convalescent camp.

It was further possible, with a considerable group of these cases, to study the period between the admission to hospital, the onset of disease or operation and the moment at which the subject had proved himself fit for full duty.

In other words, these convalescent camps in war offered for the first time, so far as I am aware, an opportunity to obtain information as to the average duration of convalescence from ordinary medical and surgical conditions in the normal young adult. The figures published in the article soon to appear by Captain Bridgman and shown on the chart are suggestive. They emphasize the point with which I began, namely, that in medical practice the question of convalescence is sadly neglected.

TABLE SHOWING THE AVERAGE TOTAL PERIOD IN HOSPITAL AND CONVALESCENT CAMP OF MEN DISCHARGED TO DUTY.

(MODIFIED FROM BRIDGMAN.)

MEDICAL CONDITIONS.		
Diagnosis.	No. of cases.	Average total stay in hospital and camp.
Influenza	828	31
Pneumonia	170	58
Acute bronchitis	233	36
Mumps	53	39
Measles	18	27.
Scarlet fever	7	77
Catarrhal jaundice	7	38
Diphtheria	5	57
Tonsillitis and sinusitis	90	34
SURGICAL CONDITIONS.		
Hemorrhoidectomy	25	45
Herniotomy	41	50
Hydrocelotomy	7	54
Tonsillectomy	8	37
WAR CASUALTIES.		
Gas	1195	37
Enteritis	512	30
Concussion	192	45
Exhaustion	80	40

When we consider, as Bridgman has pointed out, that it takes a robust young soldier thirty-four days to pass through and recover from the effects of an acute tonsillitis, fifty-eight days from a pneumonia, seven weeks from a herniotomy, five weeks from a tonsillectomy, with all the advantages offered by a convalescent hospital, we may well pause and reflect.

The grave sequels of so many acute infections, especially the psychoneurotic phenomena following operations and many of the continued fevers, might well be in part avoided if we possessed in civil life opportunities to offer that which we were beginning to provide for the care of our troops in France—adequate care of con-

valescence. It is easy to see what an immense advantage such institutions for the care of convalescents would be to large industrial institutions. It is equally easy to comprehend the grave difficulties which would attend the conducting of such an institution in civil life. Nevertheless, it is clear that convalescent departments are needed and should be started in connection with our large hospitals; not convalescent homes, but institutions under the charge of active and specially trained physicians; institutions in which every arrangement for the well considered rehabilitation, mental and physical, of the convalescent may be carried out. Here in America the admirable work of General Hospital No. 9, at Lakewood, has shown what symptomatic, physical and mental training may do for the large body of slightly subnormal individuals from whose ranks a considerable percentage of the effort syndrome were derived. The treatment of these cases differs in no essential from that which should be afforded to convalescents in civil life.

If our experience in this war shall help to awaken a new interest in the care of convalescence and shall convince the medical profession and the general public of the importance of suitable physical training in the rehabilitation of the inefficient, a beneficent advance will be made in the art of medicine.

CARDIAC DIAGNOSIS IN THE LIGHT OF EXPERIENCES WITH ARMY PHYSICAL EXAMINATIONS.¹

By LEWIS A. CONNER, M.D.,

NEW YORK

DURING the period of nineteen months which elapsed between the entrance of the United States into the war and the signing of the Armistice, approximately 4,000,000 soldiers, most of them recruits, were subjected to a special physical examination of their circulatory apparatus by officers chosen for their supposed special fitness for this work. No similar examinations upon any such gigantic scale have ever before been attempted.

It seems appropriate at this time to attempt to take stock of what has been accomplished by all this elaborate effort; to inquire whether, in the first place, the direct and immediate benefits to the army have been such as to justify this effort; and, in the second place, whether these examinations have added anything of permanent value to our knowledge of cardiac disorders or of cardiac diagnosis.

¹ Read at the meeting of the Association of American Physicians, Atlantic City, June, 1919.

In the present paper no attempt will be made to answer the first query further than to express the belief that the results of the policy of the Surgeon-General of having the cardiovascular examinations of recruits made only by officers of special training and qualifications have more than justified the added expense in personnel, time and money.

As for the question as to whether anything of permanent value has been added to our knowledge of cardiac disorders and of cardiac diagnosis, that can be answered unhesitatingly in the affirmative. There can be no doubt that a real advance has been made in certain phases of cardiac diagnosis, and it is interesting to note that this advance was made not through refinements in laboratory technic or by means of more delicate instruments of precision, but chiefly through the opportunity afforded to examine an immense number of young men, almost all of whom were normal subjects, and to learn the frequency and the extent of normal variations of the physical signs of the heart. This extension of our knowledge of the normal variations I should be inclined to place as the most important gain made in cardiac diagnosis. Next to this should be put the gain in knowledge of the functional disorders of the heart, especially of the so-called irritable heart; and, third, I should place the advance in the diagnosis of the milder forms of organic valvular disease.

Three types of cardiac disease, which in civil life are among the commonest seen by the hospital physician, were conspicuous by their rarity: (1) as was to be expected, the degenerative conditions common to middle and old age; (2) the severe forms and the advanced stages of rheumatic valvular disease, and (3) syphilitic disease of the aorta and heart. The extreme rarity of syphilitic disease deserves in passing a word of emphasis. Among 1,000,000 examinations of drafted recruits there were 11,562 rejections for cardiovascular disorders. Of this number only 20 were rejected, with the diagnosis of thoracic aneurysm. While this figure doubtless does not represent fully the incidence of the disease, and while an occasional aneurysm manifested itself during military service, they were, nevertheless, extraordinarily rare. Much the same may be said concerning the syphilitic type of aortic insufficiency which all the available evidence shows to have been extremely rare, even among the negro troops. Indeed, when one considers the incidence of syphilis among males between the ages of twenty-one and thirty-five years, one might venture, on the basis of the army examinations, to formulate something approaching the dignity of a law, to the effect that *in cases of acquired syphilis the clinical evidences of involvement of the aorta and heart almost never appear before the thirty-fifth year.*

The examiners, as has been said, were selected for their supposed special fitness for this work, as shown either by their past experience

or by their response to the special training furnished them by the army schools. Although it would be incorrect to say that all of these several hundred special cardiac examiners possessed exceptional qualifications for the work in hand, it is unquestionable that many of them did. In making up the various groups of examiners, pains were taken to see that in each group at least the officer in charge should be known to be a clinician of experience and special training. Moreover, with the records at hand from the examining boards of each of the fifty or more camps and recruiting stations it was possible to establish averages and controls by which to assess the diagnostic accuracy of the individual boards. Supervision and control were further exercised by occasional visits of inspectors and consultants. In these various ways it was possible, therefore, to keep in touch with the work done in the different camps and to ascertain the difficulties and common errors in diagnosis. Methods of examination and criteria of diagnosis were standardized, insofar as possible, by rules prescribed by the Surgeon-General and issued first in the form of a circular of instructions. These instructions were drafted with consummate skill by the late Major T. C. Janeway, and have formed the basis for all the later rules governing such examinations included in the selective service regulations.

NORMAL VARIATIONS OF PHYSICAL SIGNS. As has been said a realization of the fact that the physical signs of the normal heart are subject to much more frequent and much wider variations than has generally been supposed is to be regarded as one of the important gains for cardiac diagnosis which has come out of the war experiences. These variations affect every type of cardiac physical sign; the position of the apex-beat, as shown by inspection and palpation, the distinctness and character of the cardiac impulse, the area of cardiac dulness, the character and intensity of the heart sounds, all are subject to surprisingly wide variations in perfectly normal individuals. Only a few of the more important of these variations can be discussed here.

The distinctness and the character of the cardiac impulse depend to a very marked degree upon the special conformation of the thorax. If the latter is deep and roomy only a faint and sharply localized apex-beat will be seen and felt. If, however, as often happens, the chest is flat and the space between the bodies of the vertebræ and the sternum very small the heart gives the impression of being flattened up against the chest wall, and there is a marked visible and palpable impulse which may involve all the precordium to the left of the sternum and occasionally even the sternum itself. This together with the associated large area of dulness may readily be misinterpreted as indicating the existence of some cardiac enlargement.

The character and intensity of the heart sounds vary greatly in different individuals under similar conditions and in the same

individual under different conditions. Rest, exercise, excitement and change of posture all have their effect in modifying the character of the first heart sound and in changing the intensity of both sounds.

ACCIDENTAL MURMURS. In the modification of the first heart sound the point at which such a changed sound deserves to be called a murmur is one concerning which disagreement is common, but even under the most rigid interpretation of the term the occurrence of such systolic accidental or functional murmurs is surprisingly frequent. When the murmur is located over the base of the heart its true nature is much more likely to be recognized than when it is apical, and yet such apical accidental murmurs are very common. It is not possible to give accurate statistics, but I am convinced, in the light of my own experience, that it would be conservative to say that at least nine-tenths of all apical systolic murmurs in young adults belong to the class of accidental or functional murmurs. Rothschild's figures, which bear upon this point, will be quoted in discussing mitral insufficiency.

These apical systolic accidental murmurs have several features by which they can usually be recognized. First and foremost is their inconstancy. They may be absent during rest and be pronounced after exercise or during excitement. The first sound may be quite clear and normal in the erect posture and have all the characteristics of a murmur in the recumbent position; in the second place they usually show no tendency to be transmitted to the left of the apex; then, too, the murmur is obviously only the modified and changed first sound; it is not something clearly distinct from and additional to the heart sound as is so commonly the case with the murmur of mitral insufficiency. Lastly, such accidental murmurs seem rarely if ever to have the peculiar high-pitched, whizzing or blowing quality usually possessed by those due to mitral insufficiency.

The basal systolic accidental murmurs have much the same characteristics as those at the apex. When heard only to the left of the sternum they are usually readily recognized; but when, as occasionally happens, they are audible over both the pulmonic and the aortic areas, they may be mistaken for the murmur of aortic stenosis.

DIASTOLIC ACCIDENTAL MURMURS. The teaching that accidental murmurs are always systolic in time is in general sound even although the statement is not strictly true. Exceptions to that rule do occur, but they are certainly rare. I have myself seen three undoubted instances of diastolic cardiorespiratory murmurs heard over the base of the heart and bearing a very close resemblance to the murmur of aortic insufficiency. Two of these cases were young officers in whom the murmur had been accidentally discovered, and who after examination by a board had promptly been recommended for discharge because of aortic insufficiency.

THE IRRITABLE HEART OF SOLDIERS. (*The Effort Syndrome, Neurocirculatory Asthenia.*) Notwithstanding the fact that for nearly fifty years almost every text-book of medicine has contained some account of the condition described by Da Costa as "the irritable heart of soldiers," it is nevertheless true that up to the beginning of the war a practical knowledge of that disorder was entirely lacking. It is doubtful if one physician in a thousand had ever ventured to make the diagnosis or had any confidence in his ability to recognize a case if he should see it. It was generally looked upon as an affection peculiar to war conditions and without its counterpart in peace times.

From the very first day of the army heart examinations, however, this neurosis obtruded itself upon the consciousness of the examiners in no uncertain manner. It was far away the commonest disorder encountered and transcended in interest and importance all the other heart affections combined.

One of the most surprising things about the "soldier's heart" was the discovery that in a majority of the cases the symptoms of the disorder were not first manifested under the strain and stress of war but had existed in the recruit for years, often for many years, before the onset of his army career. These cases made up the so-called constitutional type of the disorder.

In another large group of cases the symptoms appeared in previously healthy men after an attack of acute illness, such as pneumonia, dysentery, rheumatic fever or influenza. In most of these "post-infectious" cases there is no reason to suppose that the fact that the patients were soldiers bore any direct relation to the development of the neurosis.

It is clear, therefore, that the affection is far from being peculiar to the conditions of war or to army life. Only a small proportion of the cases have their origin in such special conditions. Obviously, then, the syndrome must exist and must be of fairly frequent occurrence in peace times, notwithstanding the fact that heretofore we have failed so completely to recognize it. With the knowledge of the disorder gained in the war, however, there should be no question of its proper recognition in the future, and the dissemination of this knowledge throughout the profession will constitute one of the most important of the war's contributions to cardiac diagnosis.

All the experience of the army heart examinations has shown the great danger, even with experienced examiners, of mistaking this neurosis for some organic disease of the heart, in contrast to the very rare error of mistaking such organic diseases for the effort syndrome. The "soldiers' hearts" were very apt to be diagnosed either as myocarditis or as mitral insufficiency or mitral stenosis. It was indeed often difficult to believe that a soldier who, on even moderate exertion, showed such an array of striking

symptoms (dyspnea, exhaustion, precordial pain, tremulousness, cyanosis, extreme tachycardia) could be suffering merely from a neurosis. Moreover, certain of the physical signs sometimes bore a close resemblance to those of mitral insufficiency and mitral stenosis. The pronounced and widespread cardiac impulse often suggested cardiac enlargement; the first sound at the apex was usually extremely short and sharp and the second pulmonic sound often very loud; a systolic accidental murmur was sometimes present and the suggestion of a thrill was often given to the palpating hand in the apical region. Because of the rapid heart-rate it was sometimes easy to persuade one's self, erroneously, that this slight thrill was presystolic in time. Thus with such a combination of pronounced symptoms and suggestive physical signs it is not surprising that a good deal of time was needed to educate the great body of medical officers to the true nature of these cases.

DIAGNOSIS OF THE MILD FORMS OF VALVULAR DISEASE. The progress made during the war in the diagnosis of valvular disease has been chiefly in the direction of recognizing the need for much greater caution in making such diagnoses than was formerly generally believed to be necessary or proper. The recognition of the great frequency of normal variations from the conventional physical signs, including the prevalence of systolic accidental murmurs, as well as the knowledge gained concerning the effort syndrome and the readiness with which it may be mistaken for valvular disease, has led to the conviction that in the past this latter diagnosis was made much more frequently than it deserved to be.

The instances of valvular disease encountered in the army examinations were, practically all of them, of mild type—all the more severe and obvious cases had been eliminated by the examinations of the local draft boards—and it was characteristic of these mild forms of valvular disease that symptoms, as distinguished from physical signs, were entirely lacking. These men, almost without exception, gave a normal cardiac response to exercise, showed the same degree of physical strength and endurance as normal men and could be distinguished from these only by the physical signs of the heart.

It remained throughout the war an amazing paradox that a disorder in which the heart was known to be intrinsically normal should give rise to such pronounced cardiac symptoms, whereas the cases of valvular heart disease were so completely free from symptoms.

Concerning the diagnosis of lesions of the aortic valve there is little to say. These lesions were rare and were usually correctly diagnosticated. Not more than one recruit in every thousand was rejected for disease of the aortic valves, although every such case discovered was rejected. Aortic insufficiency was the one valvular lesion in which the tendency to err was in the direction of making

the diagnosis too infrequently. When the diastolic murmur was faint and high pitched it was occasionally overlooked, and this error was, I think, due chiefly to the failure on the part of some examiners to realize that this particular murmur is often better recognized with the naked ear in contact with the chest than through the medium of the stethoscope.

With respect to mitral lesions the examinations demonstrated clearly that the correct diagnosis of the mild forms of these two valvular lesions is by no means always as simple and easy as we have been accustomed to think. They showed, further, that when mistakes in diagnosis are made they are almost invariably in the direction of finding some valvular damage when it does not exist rather than in overlooking a lesion when it is present.

MITRAL INSUFFICIENCY. The effort syndrome was the condition most frequently mistaken for mitral insufficiency, as indeed it was also for mitral stenosis. The rapid and violent heart action and pronounced cardiac impulse frequently gave the impression of cardiac hypertrophy; if, in addition, there was to be heard an apical accidental murmur the resemblance to mitral insufficiency might be close and, to the uninitiated, the diagnosis would seem to be confirmed by the pronounced subjective symptoms of precordial pain, dyspnea, palpitation, etc. With increasing experience in the recognition of the effort syndrome its confusion with mitral insufficiency became less and less frequent, for the two conditions bear little real resemblance to each other. The tachycardia, which is so constant and marked a feature of the "soldiers' heart," is no part of the clinical picture of mitral leakage, and, as has been said, the pronounced subjective symptoms were characteristic of the neurosis and were altogether lacking in the valvular cases.

The question has been much discussed of late as to whether one is ever justified in making a positive diagnosis of mitral insufficiency on the existence of an apical murmur alone, and in the absence of signs of hypertrophy and of a history of definite attacks of rheumatic fever, even though the murmur have those special characteristics of transmission and quality which are supposed to belong to that disease. My own attitude toward this question has been modified a good deal by my army experiences and without venturing to be dogmatic upon the subject I am inclined to believe that one will make fewest mistakes in the diagnosis of mitral regurgitation by adhering to the rule of never venturing a diagnosis on the presence of a murmur alone, no matter how characteristic it may seem to be. It is certain that if this rule were generally followed uncomplicated mitral insufficiency would take its place among the less frequent forms of valvular disease, as I believe it deserves to do. In this connection the statistics of Rothschild² are very instructive. Assuming

² Jour. Am. Med. Assn., February 1, 1919, lxxii, 327.

the chief criteria for the diagnosis of mitral regurgitation to be (1) cardiac hypertrophy, (2) an apical systolic murmur and (3) a definite history of rheumatic fever, and arguing that the presence together of (1) and (2), or of (2) and (3), should at least raise a grave suspicion of valvular disease, he analyzes the records of the examinations of 10,000 recruits, accepted for limited service, with these points in mind. Among this number there were 870 cases with recorded systolic murmurs, of which only 33, or 3.8 per cent. fulfilled the above requirements for the diagnosis of mitral insufficiency.

MITRAL STENOSIS. The physical signs of mitral stenosis are usually so distinctive and striking that it may be hard to understand why much difficulty in its diagnosis should have occurred. As a matter of fact, however, there was constantly a tendency to mistake cases of "soldiers' heart" for this form of valvular disease. This tendency was much more pronounced at first than later on, but even when the clinical picture of the effort syndrome had become a familiar and well understood one there were still occasional cases in which the differential diagnosis between this neurosis and mitral stenosis was very difficult. In the former condition the heartbeats are not only very rapid but are usually quick and forcible in character; the apical impulse often is sharp and tapping, the first sound short and sharp and occasionally a suggestion of a thrill may be felt which, because of the rapid heart rate, it is difficult to time accurately. All these signs bear resemblance to those of mitral stenosis. Occasionally, too, the first sound is impure or reduplicated, and it is easy to fancy that this is really a very short presystolic murmur.

These physical signs are often very much like those of the heart in exophthalmic goiter, which, as is well known, may closely simulate the signs of mitral stenosis. There are, however, certain differential points which will usually suffice to clear up the uncertainty between the effort syndrome and mitral stenosis. In the first place a rapid heart rate *during rest* is very exceptional in the mild forms of mitral stenosis under consideration. Usually the rate is quite normal, although it may become rapid upon even slight exertion or under excitement. On the other hand anything approaching a normal heart-rate, even during rest, is very unusual in the "soldier's heart."

In the next place a distinct and unmistakable presystolic murmur is so constant a sign of these mild cases of stenosis that this diagnosis is not justified, I think, unless the murmur is heard. It may be audible only in certain postures or only after some exertion, but is rarely, if ever, lacking entirely. No matter how suggestive the other physical signs may be, the diagnosis, in my judgment, cannot safely be made in the absence of an unmistakable presystolic murmur.³

³ This view accords with that expressed by Lewis in his recent admirable monograph on the Soldier's Heart.

Finally, in the mild grades of valvular disease there are lacking all the pronounced symptoms of dyspnea on exertion, faintness, precordial pain, palpitation, tremulousness, cyanosis and sweating, which are such a characteristic part of the clinical picture of the effort syndrome. Two procedures have been suggested recently as aids in clearing up the diagnosis in doubtful cases of mitral stenosis. Morison⁴ has found that the inhalation of nitrite of amyl will sometimes cause a doubtful murmur either to become more distinct or to disappear. Rothschild⁵ has sought to bring out the murmur in doubtful cases with very rapid heart action by slowing the heart by the use of ocular pupillary pressure.

SUMMARY. The examination of the cardiovascular apparatus of immense numbers of soldiers by specially qualified medical officers has resulted in a distinct gain to our knowledge of certain phases of cardiac diagnosis. This gain has been chiefly in three directions: A better appreciation of the extent and the frequency of normal variations from the conventional physical signs of the heart; the recognition of the importance and frequency of the syndrome known as the irritable heart of soldiers or the effort syndrome, and an increased accuracy in the diagnosis of the mild forms of valvular disease, especially of mitral insufficiency and mitral stenosis.

Variations from the conventional physical signs of the heart are extremely common in normal individuals and affect every type of physical sign. Of these the systolic accidental or functional murmurs heard at the apex and in the pulmonic area are the most important and the most likely to lead to errors in diagnosis. It is believed that fully nine-tenths of all apical systolic murmurs belong to this class of accidental or functional murmurs.

The neurosis known as the irritable heart of soldiers has been the most frequent, and much the most important heart disorder encountered during the war. Because of the pronounced cardiac symptoms associated with it and the suggestive physical signs it is very likely to be mistaken for some organic disease of the heart, especially for mitral insufficiency or mitral stenosis. The knowledge gained of this disorder during the war indicates that only a minority of the cases have their origin in conditions peculiar to war and that the condition must have existed, and been far from rare, in civil life in spite of our failure to recognize it.

The army examinations have demonstrated that the mild grades of valvular disease, which were almost the only types encountered, show a cardiac reserve power well within normal limits and are remarkably free from subjective symptoms. In this respect they offer a striking contrast to the effort syndrome in which such symptoms are usually pronounced.

⁴ British Med. Jour., April 20, 1918, i, 452.

⁵ Jour. Am. Med. Assn., March, 1919, lxxii, 652.

The inclination to diagnosticate mitral leakage upon the presence of an apical systolic murmur alone is to be resisted. In the absence of evidences of cardiac hypertrophy or of a history of definite attacks of rheumatic fever it is doubtful if one is justified in making the diagnosis even though the murmur have those features of transmission and quality which are supposed to be characteristic of that disease.

In view of the danger of mistaking cases of soldiers' heart for those of mitral stenosis the latter diagnosis should not be made unless an unmistakable and characteristic presystolic murmur be present.

The extraordinary rarity of cases of syphilitic disease of the aorta and heart among the men examined seems to indicate that the clinical manifestations of syphilis in the aorta and heart almost never appear before the thirty-fifth year.

REPORT OF A CASE OF RUPTURE OF AN AORTIC ANEURYSM INTO THE LEFT INNOMINATE VEIN.¹

BY JAMES B. HERRICK, M.D.,

CHICAGO.

THIS case is reported simply in order to place on record another instance of rupture of an aneurysm of the aorta into the superior vena cava. I speak of rupture into the superior vena cava, though actually the rupture was into the left innominate vein, less than 1 cm. from the cava, the opening of communication being 1.5 cm. in diameter. The autopsy (Dr. B. A. Raulston) further showed marked old and active aortitis, typically luetic. The aneurysm had its origin 4 cm. above the aortic valves, the rounded sac, some 7 cm. in diameter, projecting in such a way as to produce a pressure constriction of the superior vena cava, especially marked close to the heart where it would clearly almost completely shut off circulation in the cava and block the azygos vein. The innominate and azygos veins were "hugely distended."

The diagnosis made after an examination of the patient who came under my care in the Presbyterian Hospital January 12, 1919, was aortic aneurysm, with rupture into the superior vena cava. While I had never before seen a case of this sort, I remembered having heard Dr. Stengel make a report of one before this Association in 1900. On reading Dr. Stengel's² article one was referred to the fuller discussion of the subject by Pepper and Griffith³ in their

¹ Read at the meeting of the Association of American Physicians, Atlantic City, June 17, 1919.

² Tr. Assn. Am. Phys., 1900, xv.

³ Ibid., 1890, v.

paper of 1890, also presented to this Association. In 1906, also, Fussell⁴ had reported an additional case as had Cary.⁵ A study of these reports, and particularly of the comprehensive digest of the topic by Pepper and Griffith, left little doubt that my case was of this nature.

Epitomized, as was done by Pepper and Griffith, the diagnosis rests on the following facts:

1. *Evidence from the History and Physical Examination*—including the tests for syphilis and the examination by the roentgen ray, both made available since the time of the Pepper communication—that an aneurysm exists in the thorax.

2. *The Sudden Onset of Symptoms attending the Rupture.* Other pressure causes may lead to edema and cyanosis; the aneurysm itself may have produced these results. But with the rupture there is nearly always a recognition by the patient, as in my case, of a sudden giving way of something in the chest, a rapid increase in the swelling, cyanosis, dyspnea, etc.

3. *"Cyanosis, Edema, Coldness and Distention of the Veins of the Upper Part of the Body, with other Evidences of Obstruction to the Circulation of the Blood in the Tributaries of the Superior Cava."* If there is no obstruction below the point of entrance of the azygos vein, edema of the chest wall will be lacking; there would also be less likelihood of marked hydrothorax. The degree of cyanosis and dyspnea has varied in the cases reported. In mine it was extreme.

4. *A Murmur Heard toward the Base of the Heart.* This is usually continuous, with a ventricular systolic crescendo. The diastolic portion of the murmur is due to the current during arterial systole. In some cases a murmur only with the systole of the ventricle has been described. Evidently the type cannot be regarded as fixed, for the condition of the aortic valves, the extent of roughness of the aortic lining, the degree of elasticity of the arterial wall and the bruit in the aneurysmal sac must differ and contribute varying factors to the murmur. The most suggestive feature seems to be the continuousness of the murmur. "Like that heard in the enlarged vessels of a thyroid gland"—"a murmur characteristic of a communication between an artery and a vein." The murmur in my case resembled those which I have sometimes heard in cases of patent ductus Botalli.

The history was obtained with difficulty because the effort of talking increased to an alarming extent the cough and dyspnea; besides, the patient was extremely irritable and at times delirious. He was a physician, aged thirty-three years. For six months he had suffered from pains in the chest which at times went out into the right arm. He admitted that he had "aortic disease," but whether by this he meant valvular disease or aneurysm was not clear. He

⁴ Tr. Assn. Am. Phys., 1906, xvi.

⁵ Ibid., 1906, xvi.

denied syphilis, though the Wassermann test made a few days later was strongly positive (++++).

On the evening of December 9, 1918, he returned late to his office. As he was ascending the stairs he experienced a feeling as of something giving way in his chest; his neck and face felt flushed and full. The sense of choking and pressure was so urgent that as he entered the office he violently tore open his collar and the neckband of his shirt. While trying to turn on the electric light he lost consciousness. How long he lay in a swoon on the floor was not known; he thought about twenty minutes. After regaining his senses he turned on the light, looked in the mirror and saw that his face and neck were greatly swollen and "almost black in color." Breathing was difficult. He gave himself a hypodermic dose of some digitalis preparation and later summoned aid by telephone.

The history of the next five weeks is lacking in details; however, these are not essential to the story. As gathered from the patient and his wife there was most distressing dyspnea, much of the time amounting to orthopnea. Stormy spells of cough, with strangling and choking sensations and extreme cyanosis, seemed at times to threaten immediate death. The swelling of the face, neck and upper part of the body had been a striking feature of his illness, being noted almost from the first. There had been great difficulty in securing sleep even with the help of opiates. He had taken but a small amount of food, claiming that he had no appetite and that food distressed him. The thermometer had shown no rise in temperature. He had grown very weak, was irritable, unreasonable and at times somewhat delirious.

The picture presented, as I saw this patient for the first time five weeks after his accident, was one of which I have never seen the duplicate. The neck and face as well as the wall of the chest were swollen as in the anasarca of chronic parenchymatous nephritis; the injected, bulging eyeballs could be seen through the narrow slits left between the swollen lids. But instead of the pasty pallor of the nephritic facies there was a purplish, almost black color, such as is seen only in the most extreme degrees of cyanosis. The visible veins were distended and tortuous. But no feature was more remarkable than the sharp contrast between the bloated, dark, upper half of the body and the pale, emaciated lower portion. The legs were the spindle legs of one in the terminal stages of a wasting disease, with no swelling and no pitting on pressure. There was no sign of free fluid in the scrotal sac or in the abdominal cavity. The liver was just palpable. The abdominal wall itself was not edematous except slightly so above the umbilical level. The line of separation between the non-swollen pale, flaccid abdominal wall and the swollen, purplish chest wall whose skin and subcutaneous tissue felt hard and brawny, pitting only on quite firm pressure, was almost as clear-cut as is the line of demarcation in a case of gangrene, being distinctly marked close to the costal margins.

Cardiac outlines were difficult to determine because of the thick, edematous chest wall, but the heart was evidently located somewhat to the left. And it was plain that there was an increased area of dulness at the base of the heart and over the manubrium. Here also could be very clearly heard the murmur already described, which is referred to in the history sheet as follows: "A systolic murmur which lasts into diastole is heard over the precordium in front and the interscapular region behind. At the aortic cartilage the murmur is particularly distinct and most intense. Here it is continuous, soft, blowing, somewhat humming in character. It is accentuated with the ventricular systole, so that at such times it becomes a loud, slightly roughened blow." There were numerous rales, both moist and dry, over the lungs, particularly behind. At the bases was dulness with some obscuring of breath sounds as from pleural fluid.

Until his death, eight days after I first saw him, there was no change for the better, rather a gradual loss in every respect. Breathing grew more and more difficult; cough was very annoying; there developed a dysphagia of marked degree; sleep was possible only by the help of drugs; food was taken in limited quantities. There was no fever except one rise to 100° on January 15. Only occasionally was a trace of albumin found in the urine. A roentgenogram showed a shadow as from an aneurysm of the first or transverse portion of the aorta. The Wassermann test was strongly positive. The patient's mind was never quite clear, and much of the time was distinctly awry. He was irritable, unreasonable, often threatened to take his life. He gradually lost in strength, had spells of alarming cardiac weakness and finally lapsed into a condition of semistupor, from which he never fully rallied, dying January 20, 1919, at 2 o'clock in the morning.

Extended comment on this case is unnecessary, especially before this Association, to which several other similar cases have been reported and before which Pepper and Griffith presented their very complete study of the subject. The case is quite classic in its conformity to the condition as portrayed by these writers. While perforation of the aneurysm was not, strictly speaking, into the vena cava, it was so close to it—less than one-third inch—that in all essentials the case may be considered under that head.

While these typical cases permit of diagnosis if one carefully regards the history and physical findings, one may understand how variations in the size of the aneurysm, in the point of pressure on the cava, in the degree of obstruction produced and in the size of the ruptural opening may cause variations from the type, thus rendering diagnosis more difficult. Such differences in the anatomical lesion will explain the varying degrees of cyanosis and dyspnea, the absence of edema from the chest wall—azygos open—etc., in the cases as described by different writers.

Also one may understand how a mediastinal tumor might cause cyanosis, difficulty in breathing and swallowing, together with edema and venous engorgement of the upper part of the body; or how an aneurysm without rupture might lead to these symptoms. And the resemblance to the condition under consideration might be still more striking if valvular or aneurysmal murmurs or murmurs produced by pressure on vascular trunks were present. Diagnosis must at times be very perplexing. These difficulties are illustrated by a case reported by Sailer,⁶ in which there was perforation of the aneurysm into the superior cava, though there was no clinical evidence of venous obstruction. On the other hand, Fussell⁷ refers to a case in which sudden symptoms suggested perforation, yet none was found postmortem.

There is little that can be done for these patients except in a palliative way. Bleeding has been of only temporary benefit. Rest with the use of drugs to lessen distressing symptoms, such as cough, pain, sleeplessness, may tend to prolong life. Death may occur in a very short time after the accident, or it may be postponed many weeks or even months. One reported case is regarded as an instance of recovery.⁸

Fortunately the accident is rare. Pepper and Griffith, in 1890, found but 29 cases in the literature. Sixteen years later Fussell was able to add 7. The case here recorded, with 6 others found in the literature since 1906, makes a list of 43.⁹

ON THE CLINICAL SIGNIFICANCE OF POSTURAL CHANGES IN THE BLOOD-PRESSURES, AND THE SECONDARY WAVES OF ARTERIAL BLOOD-PRESSURE.

BY HENRY SEWALL, M.D.,

DENVER, COLORADO.

I. POSTURAL CHANGES IN THE BLOOD-PRESSURES.

DISTURBANCE OF THE CARDIOVASCULAR FUNCTION WITHOUT ORGANIC DISEASE. It is a trite observation that the recent trend of medical thought has been to view pathological conditions from the functional and physiological rather than from the structural

⁶ Tr. Coll. Phys. Philadelphia, 1908, 3d S., xxx, 33.

⁷ Ibid., p. 34.

⁸ Damaschino and Lavin: *La France Médicale*, 1882, i, 805.

⁹ Cases recorded since 1906: Jos. Sailer: Tr. Coll. Phys., Philadelphia, 1908, 3d S., xxx, 33. O. H. Petty: Proc. Path. Soc., Philadelphia, 1914, xvi, 47; also Jour. Am. Med. Assn., 1913, lxi, 1810. W. G. McCallum: Proc. New York Path. Soc., 1915, N. S., xv, 27. J. L. Roberts: Liverpool Med.-Chir. Jour., 1910, xxx, 96. Paul Woolley: Am. Jour. Syph., St. Louis, 1917, i, 426. Laurence Humphry: British Med. Jour., 1910, ii, 1046. Jas. B. Herrick: Case here reported.

and anatomical aspects. Thus, an organic heart lesion, however obtrusive its physical signs, may nowise impair the efficiency of the body in the execution of its daily tasks. Functionally, therefore, it is as if the engine of circulation were perfectly healthy.

But the suspicion must always be entertained that the infective nidus which occasioned the structural change is still alive, and that, under conditions favorable to itself, it may awake to new life, overcome tissue "resistance" and develop a "drive" against which we are powerless to contend.

Therefore the practical medical mind must not only consider the actual mechanical and biological condition of the damaged organ, but must entertain a prevision of what may happen by reason of adverse changes affecting its allies, the various associated activities on which it depends.

The late J. H. Musser¹ took pains to point out that while in works on the practice of medicine a greatly preponderant proportion of the text is devoted to organic diseases, in actual practice at least three-fourths of the disorders the physician is called upon to treat belong to the category of functional diseases.

In even so simple an analogue of the body as the automobile, it is interesting to observe that most of the troubles that impair the efficiency of the machine in no way implicate the structural integrity of its parts. The engine is "killed" as effectually a score of times for lack of adjustment for once that it suffers a mechanical break.

The isolated mammalian heart is a typical engine pump. At a given temperature it works steadily, undisturbed in its rhythm by extreme variations in the load it has to propel or resistance it must overcome. But in its normal environment nothing can happen without awakening its response. Its state is modified by the state of every other mechanism and its final efficiency is determined by the coördination of associated activities.

A luminous illustration of this point of view is to be found in that symptom-complex of physiological insufficiency which the Great War has placed in the limelight and which is commonly designated in this country as "neuro-circulatory-asthenia," in England as "disordered action of the heart," and which Lewis,² in a recent monograph, has denominated as "effort syndrome."

The disorder appears to be an all-around functional failure to respond efficiently to effort, and as the organs of circulation and respiration are the great motor agencies of the body, they are incriminated as the deficient mechanisms. The symptoms of breathlessness, tachycardia, palpitation, peripheral congestion, precordial pain, etc., induced by moderate exertion in the victims of this disorder, utterly unfitted them for the strenuous demands of military service.

¹ University Med. Mag., 1892, iv, 685.

² The Soldier's Heart and the Effort Syndrome, 1919,

In seeking the etiology of this syndrome it is not strange that the clinician, imbued with the current conceptions of the eerie powers of the internal secretions, should assume at once that this symptom-complex is but a manifestation of induced hyperthyroidism. But the careful observations of Addis and Kerr³ have shown that enlargement of the thyroid gland plays no part in the manifestation of the disorder. Also, a special analysis made by Lewis⁴ certifies that thyroid changes, at least such as justify a diagnosis of Graves's disease, cannot be held to explain the symptomatology. The observant genius of J. M. Da Costa first apprehended the "effort syndrome" in 1862 among the soldiers of our Civil War; since then until recent times consideration of this disorder has not burdened the literature. This lapse of more than half a century has led to a disposition to believe that the production of the effort syndrome is dependent upon war conditions, but there is little doubt that the medical examiner who will take pains to test the physiological reserve power of vital functions will be able to segregate a large proportion of unselected persons in a class belonging to this category. This preliminary discussion is thus prolonged because the present paper is an attempt to show that this class of cases is perhaps the most numerous with which the physician has to deal, and to point out certain simple procedures by which its members may be disclosed and functionally measured.

Lewis⁵ states that of some 70,000 soldiers returned to British hospitals on account of cardiac deficiency, approximately only 1 in 10 had actual or structural heart disease. About 57 per cent. of the debilitated had been recruited from sedentary or light occupations in civil life. It is interesting to note that the most salutary treatment for the rehabilitation of these patients was not bed-rest, which was found wholly pernicious, but a systematic course of graduated exercises such as was furnished by drills of increasing severity. Under such a *regimen* "50 per cent. may be rendered fit for full or light duty, while 50 per cent. should remain in the sedentary class or be discharged as unfit." Lewis⁶ writes: "The dominant etiological factor in the clinical histories of soldiers complaining of the 'effort syndrome' is infection of one kind or another." It must awaken astonishment that in the table enumerating the various suspected causes of infection the word "tuberculosis" does not occur.

Our drastic experience with the effort syndrome seems to teach anew a lesson: that the welfare of the human organism depends not alone on the integrity of its individual mechanisms but on the teamwork displayed in their activity; that the primary failure of the whole organism is a lapse of coördination in the play of related functions rather than failure in the strength of single parts. It is well-known that the mammalian heart, many hours after systemic

³ Arch. Int. Med., 1919, xxiii, 316.

⁴ Loc. cit.

⁵ Loc. cit.

⁶ Loc. cit.

death, may be restored to temporary activity. It is as if death, like the rout of a stampeded army, is due not so much to the failure of mechanical power as to the loss of a physiological morale.

It follows that an estimate of the machine efficiency of the body as a whole demands a definite examination not only of the individual vital organs but of what may be called their biological environment.

THE FUNCTIONAL IMPORTANCE OF INFECTION. Numberless data lead to the inference that cellular metabolism is subject in sign and intensity to every infringing influence. We know that the plane of irritability and the metabolic excursions of protoplasm in any cell are largely regulated by the secretions of a definite group of organs, the endocrine glands. To this universal fact of physiology the medical observer has been constrained to add another fact of analogous import to vital metabolism, and which while constituting but an accident in the life history of the normal cell, is almost as inevitable as death itself; this is, of course, infection. In the study of any animal mechanism by statistical methods we are prone to assume that our averages are made up from individuals who represent merely various grades of physiological efficiency, while, in fact, the variable fact of infection is liable to permeate our material and undermine our conclusions.

No physician needs instruction on the eerie consequence of "focal infections" or "auto-intoxications," how apparently similar conditions may produce opposite vital effects, one toxin, for example, producing vascular hypertension, another hypotension.

For a number of years I have been interested in the study of a class of cases characterized more by obvious quantitative deficiency in living energy than by definite symptoms of organic disease.

A search for the underlying cause of this functional insufficiency and instability has often, in the absence of "focal" disease, revealed evidence of a specific infection which is usually overlooked by reason of its dearth of organic signs. I have ventured to segregate this class of cases in a definite group under the title of "Occult Tuberculosis."

The subject of this condition may be an adult who apparently completely overcame a temporary outcrop of tubercular symptoms which had been detected in youth. More commonly the clinical subject has had no tuberculosis history and no sound reason can be established for believing that he is in danger of developing clinical tuberculosis. He, or especially she, presents to the medical examiner no gross organic lesion or definite diagnostic perversion of function. The symptoms are chiefly subjective: weakness, malaise, nervousness, neuralgic pain, discontent, indigestion. New methods or remedies are liable to work a gratifying cure today, but tomorrow a still more troublesome perversion crops out. This keeps on until the wearied practitioner chucks his case out of responsible care into the limbo of "neurasthenia."

Functional tests, especially such as will shortly be described in our study of blood-pressure, show imperfect reaction to the strain of effort.

The subject is below par physiologically. Of the utmost consequence in the estimate of such cases is the objective evidence that is to be elicited by auscultation of the lungs and by roentgen-ray photographs of the chest.

Auscultation almost always develops on one or both sides an increase of the normal broncophony, limited to part of an apex or extending from the root of the lung up. A change in the quality, pitch and duration, even to the development of an "echo," of the spoken sound indicates, as I have insisted elsewhere,⁷ that a physical change has involved the respiratory tissue, and that, in the vast majority of cases, such change is due to tuberculosis.

The morbid physical signs at the apex may go further and manifest a slightly prolonged and elevated expiratory breath sound or even a slight, dry, inspiratory crackling. A roentgen-ray picture of such a chest demonstrates a morbid anatomy, which, taken in conjunction with the clinical history, cannot but suggest tuberculous infiltration. There are liable to be found in the root shadows areas of density attributable to glandular fibrosis or calcification. There is more or less continuous thickening and increased density of the upper radiations or well-defined isolated reticulations and an occasional dense spot interpretable as an altered bronchial gland.

Probably no one would interpret such a picture as that of active tuberculosis; but the fact remains that these objective signs are, in the writer's experience, prone to be the counterpart of a clinical history of ill-defined morbidity in patients who, tried by the functional tests to be described, are distinctly subnormal in their physiological powers. It is impossible to determine from these data whether the pulmonary infection postulated by the objective signs is the cause or only a concomitant of the clinical symptoms.

Personally, I am constrained to assume, as a pathological entity, a condition of "occult tuberculosis" in which the disease is not progressive, in which the demonstrable lesions are those of healing, but which, nevertheless, supplies a source of toxemia inundating and debasing all the vital powers.

Having thus outlined certain pathological complications which are as inevitable in a series of biological studies as are storms to fair weather in meteorological records, it is easier to apprehend the significance of certain tests of functional efficiency which have been carried out through observations upon human arterial blood-pressure.

I had long been impressed with the importance of noting the postural changes of blood-pressure as an index of physiological condition

⁷ H. Sewall: Jour. Am. Med. Assn., 1913, lx, 2027.

and summarized the observations in this Journal.⁸ The fundamental work of Crampton⁹ in the same field was not then known to me.

The head of pressure in the large arteries is consumed in overcoming resistance of two general sorts. One is relatively constant and outside our control; it consists in the internal friction concomitant with the movement of the blood. The other is essentially variable and depends upon the gravitational relations of the blood columns determined by the posture of the body. When a person who has been lying supine stands erect his blood tends to gravitate to the lowest point and to accumulate in one or another situation exactly analogous to the water of a flowing stream. As so well emphasized by Leonard Hill¹⁰ in experiments on animals, in the feet-down posture, there is a tendency for the heart and brain to be drained of blood which gravitates downward and collects predominantly in the capacious venous reservoirs of the abdominal cavity. In changing from the horizontal to the vertical position a wholly new element of resistance is added to the blood current, that of gravity.

It is evident that in order that the blood supply to the brain and to the heart itself may not be depleted in the upright posture, there must be compensatory aids to the peripheral circulation. Without repeating the evidence already offered it may be dogmatically stated that the gravitational accumulation of blood within the abdomen in the erect posture is prevented not so much by increased energy of blood-flow from the heart as by increase of vascular tone of the splanchnic vessels and of tension in the retaining abdominal wall. A marked fall of systolic blood-pressure in changing from the recumbent to the upright position means that these compensating factors are deficient, and, with a normal abdominal wall, the deficiency must be altogether attributed to the vasomotor system.

It would be difficult to exaggerate the practical importance of this simple test of the efficiency of one of the most sensitive, most widespread and most vital of the mechanisms of the circulation. It is not uncommon for the clinical observer to meet subjects whose systolic arterial blood-pressure in the standing posture has a normal value at the beginning of an observation but begins gradually to decline and after a few minutes suddenly slumps to 80 mm. Hg. or less, and the observation must be intermitted at once to prevent the subject fainting dead away. Such a case recently came to me in the person of a young man who had been rejected as a candidate for the aviation service.

The psychic element is greatly involved in the physiological failures, as is witnessed by the statement of the young man in question,

⁸ H. Sewall: AM. JOUR. MED. SC., 1916, cli, 491.

⁹ New York Med. Jour., 1913, xcvi, 916; Proc. Soc. Exp. Biol. and Med., 1915, xii, 119.

¹⁰ Jour. Physiol., 1895, xviii, 15.

that it was only when he was in the hands of the doctor that he felt faint in the standing posture. It may incidentally be surmised that such a failure of compensation in the person of a flying aviator could easily lead to a fatal fall. I have searched in vain among the records of the experimental examination of recruits as to their fitness for aviation for a definite investigation of the problem from this point of view.

It is a striking feature in most of these cases of extreme fall of blood-pressure in the erect position that the pulse and heartbeat usually become very slow instead of quicker, as might be expected.

NORMAL POSTURAL CHANGES IN THE BLOOD-PRESSURES. In spite of all the work that has been done on the subject, there is still no general agreement as to the relative values of the blood-pressures in the recumbent and erect postures of the body. The subject is discussed in a former communication.¹¹ Observations on several hundreds of subjects lead me to the conclusion that in changing from the recumbent to the standing posture there is always a rise in diastolic pressure and a fall in pulse-pressure. That in the normal (and some pathological) cases the systolic pressure does not change materially or shows a rise.

In a great proportion of subjects coming under the physician's eye, however, there is a systolic fall of blood-pressure in the standing posture.

Barach and Marks¹² tested the gravitational effect of postural change in normal subjects supported upon a rotatable board, by means of which the body could be supported erect with the least possible output of muscular exertion. They found in the majority of cases a considerable rise in systolic pressure in the recumbent and a fall in the erect posture, the pulse-pressure usually varying in the same direction as the maximal pressure.

It should be stated that, however interesting such experiments may be, they do not represent the normal conditions in the erect posture, which is maintained by the outflow of motor energy.

EVALUATION OF THE THREE ELEMENTS OF ARTERIAL BLOOD-PRESSURE. The relative physiological value of the three elements of arterial pressure—systolic, diastolic and pulse-pressures—is of the utmost practical importance.

The clinical significance of this data justifies a brief, though necessarily theoretical, discussion. As regards systolic blood-pressure, it is the measure of vascular strain. The rupture of a weakened arterial wall is probably determined immediately not by a continuous but by a mounting high pressure, such as an elevation of 20 to 30 mm. Hg., which experience shows is prone to accompany even slight muscular exertion or psychic disturbance. The systolic pressure measures the maximal head of power available for driving

¹¹ H. Sewall: *AM. JOUR. MED. SC.*, 1916, cli, 491.

¹² *Arch. Int. Med.*, 1913, xi, 485.

the blood; when it is greatly in excess of normal, danger of rupture threatens the arteries; when it is greatly below normal no compensating mechanism can supply nutriment to the tissues.

The diastolic blood-pressure is generally admitted to measure the peripheral resistance to the circulation and to be an index of vasomotor tone. The relations of diastolic blood-pressure to the heart itself appear to have been generally overlooked. In his valuable disquisition on the mechanics of the heart, Leonard Hill¹³ points out that the heart may be regarded as a hollow sphere, the strain upon whose wall with varying area and a constant intracardiac pressure must follow the law of the hydraulic press. "When the exertion of each individual fiber is taken as constant the fluid pressure per unit area must vary inversely as the cube of the radius of curvature, or, if the pressure be regarded as constant, the exertion of each fiber must vary as the cube of the radius of curvature. . . . If the auricle or ventricle be suddenly enlarged to twice its diameter the muscle fibers must be exerted eight times as much as before to produce the same pressure."

We cannot escape the conclusion that with a given pressure upon the closed semilunar valves the strain endured by the ventricles in overcoming this pressure increases very markedly with increase in the volume of their cavities. It is at the end of the diastolic phase that the volume of the heart is greatest and at which the intra-ventricular load must be lifted over the aortic resistance.

The outstanding significance of excessive diastolic blood-pressure is that it indicates a burden laid upon the ventricles at a moment when, according to a law of hydraulics, the physical strain endured by the walls of the heart in overcoming the resistance is at a maximum.

Now enters a physiological consideration, which suggests a vital adaptation to the mechanical disadvantage of moderate cardiac dilatation, which is unparalleled in artificial pumps. This consists in the functional relation between muscular power and the length of the contracting fibers.

One of the fundamental experiments in muscle physiology is the demonstration that a skeletal muscle, properly suspended and weighted outside the body and artificially stimulated to contract, is strongest when it is longest. If the muscle is "after-loaded" at definite points in the course of its shortening it is seen that its maximum lift power is exerted at the beginning of the contraction when its fibers are longest, and that the lift power progressively decreases as the fibers shorten. As a corollary to this it is found that a given weight stretches the muscle more when it is active than when it is at rest and that the elongation is greater the nearer to the phase of maximum shortening the weight is applied.

¹³ Schäfer's Text-book on Physiology, 1900, ii, 40.

In other words, during contraction of a muscle fiber its contractility decreases but its extensibility increases. If we can apply this law for the contraction of skeletal muscle to the special form of tissue found in the heart, we may deduce certain important conclusions, such as the fact of physiological compensation for the mechanical disadvantage which the heart suffers at the end of diastole by reason of its increased volume and also the immunity the contracting ventricle enjoys from overstrain while maintaining excessive systolic blood-pressure. I ventured some years ago¹⁴ to present these considerations since when they have been essentially confirmed experimentally by investigators in the physiology of the circulation.¹⁵

Nevertheless, it is obvious that the level of diastolic blood-pressure is the measure of cardiac strain, and we must look upon this factor as a prime determinant of cardiac hypertrophy, of dilatation and of heart failure.

We might be inclined to assume that safety against heart failure is assured in proportion to the lowering of diastolic blood-pressure, but other considerations show that this would be an egregious error. Physiologists have clearly established that the blood-flow through the coronary vessels is determined by the systolic squeeze of the muscles in which they are imbedded. J. B. MacCallum¹⁶ showed that "nearly all (the fibers of the heart) begin in the auriculo-ventricular ring of one ventricle and end in the papillary muscles of the other. Those fibers which begin near the outside of one ventricle end near the inside of the other ventricle." It is believed that, owing to the spiral course of its fibers, the contracting ventricle wrings its cavity and its walls empty much as we wring the water out of a twisted cloth. The blood spurts from the coronary sinus with each systole of the ventricles. If there is thus a periodic emptying of the mural vessels during systole it is obvious that during diastole their supply of fluid must be renewed from the aorta, as Brücke long ago pointed out. The diastolic head of pressure in the aorta, then, is the driving force by which the coronary arteries are filled, and it is a fair presumption that the volume of blood sent into the heart muscle depends primarily on the diastolic arterial pressure, though the completeness of its removal is determined by the vigor of systolic contraction.

There must be a critical point in the diastolic pressure below which the nutrition of the heart must suffer from lack of adequate supply of nutriment, and it is easy to believe that a diastolic fall of pressure might cause such a loss of driving force as would lead to asystole and which could be fatal with degenerated cardiac tissue. The

¹⁴ H. Sewall: *International Clinics*, 1913, iv, 23d ser., 99.

¹⁵ S. W. Patterson, H. Piper and E. H. Starling: *Jour. Physiol.*, 1914, xlviii, 465. R. Gesell: *Am. Jour. Physiol.*, 1915, xxxviii, 404.

¹⁶ The W. H. Welch Anniversary Volume, 1900, p. 307.

clinician is only too familiar with sudden death in cases of aortic insufficiency, cases which are distinguished by the rhythmic extreme depression of diastolic blood-pressure. These accidents are prone to occur under conditions which favor gravitation of blood into the abdominal vessels, as on assumption of the erect posture after action of the bowels or by prolongation of diastole under digitalis. Such reasoning is justifiable in view of the practical importance of the conclusion to which they give rise, that heart failure is preferably the result of subnormal diastolic rather than of supernormal systolic blood-pressure.

We may even venture upon a generalization that the paramount immediate cause of heart failure is deficiency in the coronary blood supply and that in the great majority of cases the culpable factor is abnormal depression of the diastolic blood-pressure.

Our relative evaluation of systolic and diastolic blood-pressure leads to the conclusion that the former is an index of cardiac energy expended.

It throws no light on the store of reserve power of the heart. Systolic hypertension signifies arterial overstrain the results of which depend upon vascular resilience. Systolic hypotension is a sign of weakness which is prone to result in constitutional evidence of subnormal nutrition.

Diastolic blood-pressure is an index of peripheral resistance to the circulation whose functional regulation is clearly under control of the vasomotor mechanism, but which, also, has intimate relations to the elasticity of the vascular walls and obscure, though probably most important, dependence upon the viscosity of the blood.

Diastolic hypertension signifies undue strain upon the vasoconstrictor mechanism. It is the causal antecedent of cardiac dilatation and hypertrophy. The heart of aortic insufficiency forms a special case which does not invalidate the above.

Diastolic hypotension indicates a low head of pressure in the nutrient stream for the heart; it leads to asystole and its acute onset is probably the cause of fainting and of sudden death.

In a useful article Warfield¹⁷ states that the diastolic pressure registers what one may call the average peripheral resistance, and that a high diastolic pressure invariably means constant increased work on the part of the heart and leads to hypertrophy of the left ventricle; that a gradually rising diastolic pressure is more significant than high systolic pressure; that large pulse pressures are essential for the compensation of hypertension cases, decreasing pulse pressures in such cases is a sign of failing heart; that any pulse pressure below 30 mm. Hg. must be regarded as low, above 50 mm. Hg. as high.

The third element of the arterial blood-pressure which it behooves

¹⁷ New York Med. Jour., 1915, cii, 508.

the clinician to specifically attend is the "pulse-pressure." This is obtained by subtracting, at any moment, the diastolic from the systolic blood-pressure. It represents the volume of the blood wave sent out at each beat of the heart. As will be pointed out later the exact determination of the pulse-pressure is probably impossible to achieve, but working values are easily obtained. The important contributions of Erlanger and Hooker¹⁸ and of Dawson and Gorham¹⁹ and others have shown that, heart-rate remaining the same, the pulse-pressure determines the nutritive supply of the tissues—that there is a direct proportion between the two.

Normal metabolism in every organ demands that the blood stream shall irrigate it in waves exceeding a certain minimum volume. When that organ is the brain it is obvious that we should expect general constitutional symptoms to immediately attend a critical lowering of pulse-pressure in its arterial blood supply. In a personal communication, Erlanger states that a fall of PP. to 10 mm. Hg. is indicative of shock.

It should now be clear that a special field of medical investigation comprises the quantitative measurement of vital phenomena as distinct from their qualitative determination. Disturbed function and vital failure threaten to supervene whenever the energy output is much above or below certain "normal" limits which Nature has determined to mark the range of physiological activity. This study of function has its own value irrespective of the structural condition of the organ to which it appertains. Disturbed function is no proof of structural disease. Organic disease, indeed, is relatively indifferent to the individual except as it interferes with function.

Clinicians are prone to undervalue the importance of quantitative functional efficiency except through some drastic experience such as leads to the study of renal secretion preparatory to operation on the prostate gland, or when its disturbance has been manifested as an "effort syndrome" which depletes the man-power of a nation fighting for life.

THE TECHNIC OF BLOOD-PRESSURE ESTIMATION. My estimations of blood-pressure were all made by the auscultatory method with the use of the simple mercurial sphygmomanometer of Pilling, with a broad cuff. The pressures were taken first with the patient lying supine and later standing erect. The sudden weakening of sound at the end of the third phase was assumed to indicate diastolic pressure. After counting the pulse-rate, from two to four successive auscultatory determinations were made in each posture, after which the systolic blood-pressure was estimated by the tactile method—the obliteration of the radial pulse at the wrist. Perhaps it is worth mentioning that in the recumbent position the arm bearing the cuff

¹⁸ Johns Hopkins Hosp. Rep., 1904, xii, 145.

¹⁹ Jour. Exper. Med., 1908, x, 484.

should be supported paralld with the axis of the chest, otherwise it will drop sensibly below the plane of the heart.

There is a practical complication incident to the auscultatory determination of blood-pressure which has failed to receive adequate attention in the literature; brief discussions by Cook and Taussig²⁰ and by Tornai²¹ are the only definite notices I have seen of the subject. This consists in the occasional total suppression of one or more sound phases. The auscultatory failure of sound is in itself an indication of some radical functional deficiency in the circulation. Such silent phases are encountered with great frequency in the class of patients, those with weak circulation, chiefly treated in this article, but they are also found in the subjects of marked hypertension. Perhaps the commonest locus of sound failure is the so-called fourth phase; but not infrequently the whole of the first phase is absent, especially following an initial "pop" or two representing maximal pressure.

It is obvious, therefore, that determination of maximal blood-pressure by auscultation may be wholly unreliable unless supported by the tactile evidence furnished by obliteration of the pulse at the wrist, in which the maximal pressure commonly falls to 5 to 10 mm. below that obtained by the stethoscope. In certain cases a curious alternation of periods of sound and silence occurs during an observation. A good radial pulse may be maintained while the audible sound phase on the same side rhythmically comes and goes. It is plain, therefore, that tactile perception of the pulse-wave must remain the criterion of its escape from beneath the cuff.

Absence of sound phases rarely occurs during the first observation of a series, but is likely to be marked with subsequent ones. Silent phases are much more frequently encountered in the standing than in the recumbent posture. The phenomenon appears to be intimately related to the venous engorgement of the forearm. When the arterial sound has failed it may be temporarily restored by releasing the cuff pressure and elevating the arm above the head, thus draining the veins.

The form of stethoscope used in auscultation is not indifferent. I have heard sounds by use of the disk instrument of Bowles which were inaudible through the bell of the ordinary Snoton stethoscope. Curiously, the reverse fact has been observed in a case in which the sound was a venous hum in the neck.

Writers are prone to assert that in cases presenting the condition of aortic insufficiency there is no fifth phase—that the arterial sounds persist to the point of no cuff pressure. I find, on the contrary, that many cases of aortic regurgitation present the normal succession of sound phases

On the other hand, not infrequently I have found the sound phases

²⁰ Jour. Am. Med. Assn., 1917, lxviii, 1088.

²¹ Ztschr. f. klin. Med., 1910, lxx, 235.

to persist to the bottom of the mercury column in persons in whom no certain evidence of aortic insufficiency could be detected. Such a phenomenon may occur with the first of a series of observations with a return to normal in later ones, and it is more common in the erect than in the recumbent posture.

Each of my series of observations has consumed fifteen to thirty minutes, or in special cases more than an hour, for reasons which will be obvious in the final section of this paper. The data used have been drawn from 365 series of observations on 250 persons, approximately within the past year and a half.

SIGNIFICANCE OF POSTURAL AND RESPIRATORY VARIATIONS IN RATE OF HEARTBEAT. It is a matter of general knowledge that the pulse-rate increases on changing from the recumbent to the erect posture. The elevation in heart-rate in the standing as compared with the recumbent posture is subject to wide variations in the normal individual. The average increase of beats may be taken as twelve to fourteen per minute.²²

An impressive result of such experiments as will be detailed is that patients suffering from cardiovascular disease may show remarkably slight change of rate with posture.

Finally, there may be mentioned a rhythmic variation in heart-rate which has no essential relation to posture. It is characterized by James Mackenzie²³ as the "youthful form of irregularity." It consists in a rhythmic quickening of the heartbeat during inspiration and a slowing during expiration. The current explanation of the phenomenon would seem to attribute it to influences acting on the cardiac centers in the medulla.²⁴

I venture, however, to recall in this connection experiments carried out with the aid of F. Donaldson²⁵ in 1882 and whose results had been anticipated by Ludwig and Luchsinger.

On the isolated heart-vagus preparation of the terrapin supplied by an artificial current of blood we proved that the inhibitory effect of vagus stimulation was lessened by rise of intracardiac pressure produced by increasing the rate of inflow of blood. Elevation of the supply flask by 2 or 3 c.c. had an obvious effect in diminishing the cardioinhibitory effect of a definite strength of stimulating current. Moreover, the vagus effect was found to be limited to variations of pressure within the venous sinus or sinus and auricles; that is, it depended upon stretching of the tissue in which originate the impulses to contraction. Now, under normal conditions there is increased flow of blood into and distention of the right auricle during inspiration.

²² Vierordt: *Daten u. Tabellen f. Mediziner*, 1906, p. 235.

²³ *The Study of the Pulse*, 1902.

²⁴ Cf. J. Erlanger and E. G. Festerling: *Jour. Exp. Med.*, 1912, xv, 370.

²⁵ *Jour. Physiol.*, 1880-1882, iii, 357.

Even though, as most authors assume,²⁶ there be a diminution of right-sided intracardiac blood-pressure during inspiration, the stretching of the cardiac tissues and mechanical stimulation of their contained nerves must be proportional to the volume of contained blood. We have here, then, experimental evidence of a rhythmic depression of tonic cardio-inhibitory impulses and consequent acceleration of heartbeat during inspiration.

Another point worth noting is that in those cases of circulatory insufficiency in which actual fainting is threatened through "blood ptosis" in the standing posture, there is usually not a rise in pulse-rate, as might be expected, but a very marked slowing.

DIAGNOSTIC VALUE OF THE POSTURAL CHANGES IN THE BLOOD-PRESSURES. Numerous and instructive methods have been devised for the clinical estimation of the functional efficiency of the heart. It can hardly be disputed that, as far as appreciation by the practical clinician is concerned, these methods mostly sojourn in the academic scrap-heap.

In his examination of a patient the doctor is guided by his conception of the ratio of effort to use; necessity not luxury determines his technic; the burden of a new method is intolerable unless it yields very practical results and fits easily into the routine of examination.

It is worth insisting on the conception that the efficiency of the circulation or the life and welfare of a patient with a cardiovascular disease, no more depends upon heart-power than upon a number of functions associated with it.

The excessive gravitation of blood into the limbs and belly when a person stands erect does not predicate heart disease, but does prove inefficiency of the circulation, which, for the individual, is the important thing. A certain man, aged sixty years, with dilated and probably degenerated heart muscle, manifested a fall of arterial pressure of 20 to 30 mm. Hg. on rising from the recumbent posture. One morning he sat up on the side of the bed and fell dead. The plain interpretation of the accident attributes it to blood ptosis resulting in such critical lowering of his aortic diastolic pressure that the coronary circulation ceased. Had the heart not been diseased the result would no doubt have been a temporary fainting fit. It is the possibility of such accidents that makes it important to determine the organic integrity of the heart in slight ailments and indicates caution in permitting postural changes, and especially going to stool on the part of certain cardiac patients.

The pioneer work upon the postural changes in the arterial blood pressures appears to have been presented in the important contribution of Erlanger and Hooker²⁷ fifteen years ago. They introduced the useful term "pulse-pressure" and first insisted that conclusions

²⁶ T. Lewis: *Jour. Physiol.*, 1908, xxxvii, 213.

²⁷ *Loc. cit.*

of value could only be drawn from blood-pressure determinations by taking into account both minimal and maximal pressures. In the careful study of a case of orthostatic albuminuria they showed reason for believing that the renal symptom was dependent on lessened pulse-pressure in the standing posture (it must not be concluded from this that lowering of pulse-pressure necessarily entails albuminuria).

In a lengthy discussion of the significance of pulse-pressure they concluded that under anything like normal conditions the pulse-pressure was a reliable index of ventricular output and that the product of $PP \times PR$ (pulse-pressure into pulse-rate) represents the velocity of the blood current and therefore the nutritive supply to the tissues. In an experimental research upon this problem, Dawson and Gorham²⁸ were later led to the conclusion that "Under normal conditions and during various procedures (namely, stimulation of the vagus centrally and peripherally, of the saphenus nerve centrally, and of the annulus Vieussentis, intravenous transfusions of 0.7 per cent. sodium chloride solution, intra-arterial transfusion of strong carbonate, bleeding and asphyxia) the pulse-pressure is a reliable index of systolic output."

In view of such work we must deprecate statements without evidence, like that of Warfield, that "Pathological changes in the heart or bloodvessels make this formula ($PP \times PR$) of no value."

In the normally functioning subject there is, as has been pointed out, on rising from the recumbent to the erect posture but little change or (usually) an elevation of systolic blood-pressure, a constant rise of diastolic pressure and a slight fall in pulse-pressure. Comparison of the blood-pressures in the recumbent and the erect postures gives us an unrivalled opportunity of estimating the efficiency of the vital mechanisms which compensate for the gravitational resistance to the circulation. An important addendum to the signs of vascular strain in compensating for the resistance of gravity is to be found in the increase in the heart-rate in the erect posture. Crampton²⁹ has ingeniously constructed a table representing postural changes in circulation efficiency through the combined vascular and cardiac elements.

As might have been predicted from the foregoing considerations, the postural observation of the blood-pressures has its main use in the detection of functional cardiovascular insufficiency. The victims of this condition are miserable by reason of physical weakness and nervous instability. There may be local signs, as headache, dizziness or tinnitus in the erect posture.

The class comprises a very large proportion of the patients who visit a doctor's office. Such persons habitually manifest low arterial

²⁸ Loc. cit.

²⁹ Loc. cit.

pressures, there often being a marked fall (15 to 20 mm. Hg.) in the systolic pressure in changing from the recumbent to the standing posture. Further evidence of vasotonic weakness is given by the continued subsidence of systolic pressure, as observations are continued in the standing posture, so that after ten to fifteen minutes the patient complains of fatigue or faintness. For such victims of blood ptosis no treatment seems so immediately effective as the support of a good abdominal belt. It is interesting to note that after such support has been afforded for a few weeks the belt may sometimes be dispensed with with comfort for considerable periods.

It not infrequently happens that the history of a patient leads to the prediction that evidence of blood ptosis will be found, but on taking the blood-pressure nothing of the sort is shown. Nevertheless, though the systolic blood-pressure may show no fall in assuming the erect posture the diastolic pressure undergoes an inordinate rise, leading to an abnormal drop in the pulse-pressure. Indeed, as far as numerical values of the elements of the blood-pressure serve as an index of physiological efficiency in the absence of gross organic lesions the pulse-pressure, in my experience, is the one invariable determining factor. When there are symptoms of circulatory insufficiency there will usually be found a subnormal pulse-pressure, and when the erect posture is assumed there will be an inordinate decrease in the value of the pulse-pressure to levels of 25, 20 or even 10 mm. Hg.

In 100 cases in which the pulse-pressure was low, 30 mm. Hg. or less, in the standing posture, the predominant cause of the fall of pulse-pressure was fall of systolic pressure in 10 cases; rise of diastolic pressure in 69 cases and combined fall of systolic and rise of diastolic pressure in 21 cases.

Further investigation of such circulatory abnormalities will usually, if not always, establish the existence of some focal infection such as is liable to occur in connection with the teeth or the tonsils and the removal of which I have seen followed by a return of the vascular conditions toward normal. The well-nigh ubiquitous influence of "occult tuberculosis" has already been referred to. In the choice of quickly acting remedial measures for this cardiovascular insufficiency, I have found, contrary to common advice, that the exhibition of 10 to 15 drops of the tincture of digitalis t. i. d. often does good.

Oliver,³⁰ in his interesting work, properly advocates recumbent rest after meals, with exercises, etc., directed to the increase of muscular tone, especially in the abdominal wall.

The points which have been advanced may be made clearer by a brief analysis of the paradigms of a few actual observations.

³⁰ Blood and Blood-pressure, 1901, p. 270.

BLOOD-PRESSURES.

Case No.	Sex.	Age.	Lying:					Standing:				
			SP	PR	DP	PP	PP x PR	SP	PR	DP	PP	PP x PR
1 a	M.	46	107	80	67	40		100	120	76	24	
			104		67	37		99		80	19	
			TP = 102				2680	98	TP = ?	77	21	2556
1 b	M.	..	97	76	60	37		87	120	63	24	
			96		60	36		84		67	17	
			TP = 95				2774	TP = 77				2460
2	F.	26	112	80	62	50		119	100	75	44	
			112		62	50		113		80	33	
			TP = 107				4000	103	TP = 102	80	23	3333
3	M.	28	125	88	72	53		95	120	76	19	
			122		74	48						
			TP = 115				4440	TP = 85-65				2280
4 a	M.	59	122	72	62	60		111	100	76	35	
			118		65	53		108		75	33	
			TP = 115				4068	TP = 107				3400
4 b	M.	..	132	84	62	70		125	112	75	50	
			132		66	66		120		68	52	
			TP = 130				5712	99	TP = 95	65	34	5712
5	M.	36	123	88	80	43		122	104	88	34	
			123		78	75		120		110	10	
			TP = 120				3872	123	TP = 118	108	15	2048
6	F.	14	97	80	62	35		107	104	80	27	
			97		63	34		103		90	13	
			TP = 92				2760	TP = 102				2080
7	F.	53	107	68	72	37		115	80	95	20	
			108		75	33		116		95	21	
			TP = 105				2380	TP = 113				1640
8	M.	40	109	68	71	38		108	100	90	18	
			109		71	38		109		90	19	
			TP = 105				2584	TP = 106				1850
9	F.	39	103	60	63	40		109	92	82	27	
			103		65	38		93		78	15	
			TP = 100				2160	TP = 93				1932
10	F.	42	125	90	68	57		117	120	88	29	
			125		70	55		117		90	27	
			TP = 122				5040	TP = 117				3360

In the table the blood-pressure data are given for the two postures, lying supine and standing. As for the lettering, SP represents systolic pressure; DP, diastolic pressure; PR, pulse-rate; TP, tactile pressure, determined by obliteration of the pulse at the wrist.

The column PP for each posture gives the pulse-pressure and the columns PP x PR give the product of pulse-pressure by pulse-rate, which measures the circulation velocity or irrigating volume. These latter figures were obtained by multiplying the average pulse-pressures for each posture by the corresponding pulse-rates.

The first case, 1 *a* and 1 *b* is that of a man who probably belongs to the class of occult tuberculosis. His complaint was of bodily weakness and general goodfornothingness. No active organic trouble could be detected except marked suppuration of his tonsils—they were riddled with pus.

He was referred to a throat specialist, who subjected him to extensive manipulation of his tonsils. In forty-eight hours the patient returned and the record 1 *b* was made. His condition then was most miserable from physical exhaustion, mental depression, lack of courage and initiative. He could not be persuaded to submit to operation. The physical basis of his asthenia is well demonstrated in his low systolic and pulse-pressures and by the inadequate rise of diastolic pressure standing.

Case 2 is that of an unmarried woman with high palatal arch, a typical "neurasthenic," but possessing unusual moral and mental vigor. When she stood up the circulation remained normal for a brief interval, but soon the systolic pressure began to fall and with it the pulse-pressure. She probably would have fainted had the observation been continued a few minutes longer. We have here evidence of blood ptosis due to gradual relaxation of her splanchnic vasomotor grip. The patient improved greatly under support of an abdominal belt. This case is typical of a very large class of asthenics.

Case 3 is that of a man suspected of active pulmonary tuberculosis. He gives a luminous illustration of vasomotor insufficiency and blood stagnation in the erect posture. I did not venture to keep him standing. Incidentally, the observation shows how utterly worthless for diagnosis a blood-pressure in the recumbent position alone may be.

Case 4 illustrates a remediable focal infection. It is that of a farmer who sold his property because of physical exhaustion, loss of weight and dyspeptic symptoms. Careful roentgen-ray study of the digestive organs excluded evidence of organic lesion there.

Pyorrhea and disorder of the teeth put him into the hands of the dentist. After some weeks his sense of well-being was completely restored. Observation *a* was made before treatment and *b* afterward. They show the numerical differences between a weak circulation and a strong one. It will be noted that in the standing posture of the

4 b observation the third systolic pressure has dropped from 120 to 99 mm. Hg. and the tactile pressure to 95 mm. This was after the patient had already been standing erect fifteen to twenty minutes. His powers of compensation had become overstrained; he had still far to go in the development of normal strength.

The foregoing cases illustrate abnormal lowering of pulse-pressure through fall of systolic pressure in the erect posture. The same influence on pulse-pressure is still more commonly exerted by abnormal elevation of diastolic pressure, as shown in Cases 5 to 8. As has already been indicated the most important single sign of circulatory efficiency is magnitude of the pulse-pressure. This quantity may be reduced by fall of SP or rise of DP or both combined. I am inclined to believe that important clinical deductions are potential in the differentiation of these classes. Presumably a mere drop in systolic pressure indicates vital failure, specifically of the vaso-constrictor mechanism and incidentally of cardiac energy.

But, contrariwise, an inordinate rise of diastolic pressure is evidence of a spasm of the vascular apparatus—of a strain which is excessive possibly because not properly supported by corresponding increase of cardiac energy. The vital picture here is that of a heart dilating with undelivered blood and of a vasomotor system overstrained by reason of vascular underfilling.

It may be that herein lies the explanation of the great improvement I have sometimes noted in these cases through the administration of digitalis. At all events, it is obvious that the pathological conditions leading to vasomotor exhaustion on the one hand and to vascular spasm with cardiac failure on the other deserve to be discriminated. In the subsequent section of this paper direct evidence will be offered as to the play of vascular spasm under the stress of effort.

Case 5 is that of a dentist who had recovered from tuberculosis. Infection of a finger had necessitated removal of glands from an arm. Various symptoms had led to diagnosis of and treatment for intestinal stasis. He was incapable of sustained effort and was mentally nervous and miserable. His blood-pressure in the recumbent posture was normal, but on standing there was an inordinate rise of diastolic pressure and fall in pulse-pressure, giving a physical explanation of his nerve-muscle failure.

Case 6 is that of a fairly robust young girl whose mother was a tuberculosis cure and who herself showed a roentgen-ray plate indicating latent tuberculosis. She presented orthostatic albuminuria; the low pulse-pressure while standing is noteworthy. On another occasion she almost fainted after a few minutes in the erect posture, owing to fall in systolic pressure.

Case 7 is that of an unmarried woman the victim of various miseries of a nervous character. Note the abnormal rise in diastolic pressure and fall of pulse-pressure in the standing posture,

Case 8 is that of a fairly vigorous looking man who pursued his clerical duties with difficulty on account of complete exhaustion attending the erect posture. Note the rise of diastolic pressure and fall of pulse-pressure on standing.

All these patients presented normal blood-pressures in the recumbent posture, but on submitting them to the strain of standing each developed a numerical fall in systolic or rise in diastolic pressure resulting in abnormal lowering of pulse-pressure. Such is the objective picture of cardiovascular conditions that I have found constant in scores of persons who belong to the most numerous class of functionally deficient patients who visit the "general practitioner."

Finally, the cases in which fall of PP in the erect posture is due both to fall of SP and rise of DP can be explained as results of combined cardiac weakness and vascular spasm.

Cases 9 and 10 show low pulse-pressures in the erect posture from combined lowering of systolic and rise of diastolic pressure.

Case 9 was that of a rather neurotic school teacher pulled down by anxiety and by suffering incident to a simple rectal operation.

Case 10 represents a woman of great mental activity who had recovered from pulmonary tuberculosis—who had ptosis of the abdominal viscera and myocarditis. Her life and work were tolerable only through the support given by a properly devised corset.

Exceptionally it is found that a person claiming to be well manifests in the erect posture a fall in pulse-pressure to 25 mm. Hg. or lower. When this has occurred in my experience I have been convinced that an undesirable strain was present, but compensated with avoidance of pathological symptoms.

POSTURE AS A DETERMINANT OF CIRCULATION VELOCITY. Thus far no mention has been made of the data contained in the columns headed PP x PR. As has been stated the product obtained by multiplying the pulse-pressure by the pulse-rate is supposed to represent the velocity, that is the irrigating efficiency, of the circulation. If this is true, as experimental evidence indicates, this product would seem to be one of the most important data that could possibly be desired for estimating the effective work accomplished by the engines of the circulation.

In their experiments, upon two subjects, one of whom was an albuminuric of the orthostatic type, Erlanger and Hooker³¹ found that the product representing blood movement was sometimes greater in the recumbent than in the erect posture, sometimes the reverse. They take pains to point out that in no case was there great discrepancy in the figures representing circulation velocity in the two postures. A glance at the columns headed PP x PR in my table will show that in every case the blood velocity in the

³¹ Loc. cit.

recumbent posture was considerably in excess of that manifested while standing. Indeed, in Case 3 there was a falling off of more than 51 per cent. in the blood movement when the patient stood erect. It seems at first blush a manifest absurdity that the velocity of blood movement should increase when the body is in repose as contrasted with a state of comparative activity; but further examination leads to some interesting practical deductions which are so weighty as to be worthy of rigid investigation.

The class of people treated in this paper is admittedly chiefly composed of persons manifesting pathological symptoms caused by functional insufficiency of the circulation. In the few normal persons or those approaching normal, whom I have examined the product $PP \times PR$ is usually greater in the standing posture. It might be thought that the method would find its criterion of reliability in the discrimination between cases with and without organic heart disease. On the contrary the product $PP \times PR$ appertains solely to function. In a small series of 8 cases of cardiovascular disease I found that with good compensation, with one apparent exception, the product was greater in the erect than in the recumbent posture; the reverse was true in proportion to the decompensation. It should be observed that the absolute value of the product increases and therefore may be of diagnostic significance in cardiovascular disorder.

The foregoing considerations seem, at least, to demand a definite inquiry into the fundamental question whether circulation efficiency is actually determinable by the postural changes in blood velocity as indicated by the product $PP \times PR$.

In the normal subject or in cases of well-compensated organic disease the ratio is near unity or exhibits an excess of work done in the erect posture. In cases of functional circulation-inefficiency or in a decompensated cardiovascular disease, as far as my experience shows, the reverse is true and the relative decrease of velocity in the erect posture is somewhat proportional to the disability.

This conception throws light from a new direction upon the fundamental clinical experience that in certain active disorders, as tuberculosis, rest in the recumbent posture has a remedial value unparalleled by any other method of treatment.

II. THE SECONDARY WAVES OF ARTERIAL BLOOD-PRESSURE.

Every student in physiology has seen demonstrated on animals the three undulations of maximal arterial blood-pressure which are, respectively, caused by the heartbeat, the respiratory movement and variations in peripheral resistance or vasomotor tone (Traube's waves).

The first of these, due to the rhythmic output from the left ventricle, ceases only with life and may be called primary. The others are secondary and vary in magnitude with the depth of

breathing or with the amplitude of the oscillations of vasomotor tone. It is probably correct to assume that millions of readings of the sphygmomanometer have been made without perception of the existence of such waves in the human being.

The monographs devoted to the study of blood-pressure ignore this phase of the subject or consider it only as of academic importance. Even the journal literature is relatively scant in this field of observation.

Studies conducted through a considerable number of years constrain the writer to assert that the secondary waves of blood-pressure are practically always to be discerned in estimations of the systolic blood-pressure by the auscultatory method. So plain is the phenomenon, at least as regards the occurrence of the respiratory waves that, once having observed it the ear can hardly fail to note the rhythmic ebb and flow of "pops" at the beginning of the "first phase."

It may be assumed that no such constant phenomenon in the play of a vital mechanism can be unworthy of study or without physiological or especially pathological importance. The main object of the following observations has been to attempt an evaluation of the secondary waves of blood-pressure as a basis for an estimate of the state of mobilization of the mechanisms, respiratory and vasomotor, which are indispensable allies of the cardiac function. As was indicated at the beginning of this paper, it may well be that a study of these subsidiary phenomena will convey to the clinician earlier diagnostic and prognostic information of the vital status of his patients than observations upon the heart and vessels themselves.

Comparatively few of my subjects manifested organic disease of the heart, arteries or kidneys. Most of them complained of symptoms of "functional" origin or belonged to the class I have described under the title of "occult tuberculosis"; a few would be regarded as "normal." The observations were carried out as already described, blood-pressures being taken first in the recumbent then in the standing posture. The patient was told to relax and make no conscious effort.

The disk of a "Bowles" stethoscope was held by an encircling band upon the artery at the bend of the elbow. After recording the rate of the pulse the air-pressure within the cuff was raised until it just exceeded the maximal arterial pressure. The pressure was then slowly released until the first "pop," indicating the escape of blood from under the cuff, was heard. Note was taken of the phase of respiration at which this occurred and the pressure was held at this point through at least one full respiratory movement. The pressure being gradually lowered it was easy to trace the respiratory sequence of the events of the "first phase," and with fingers on the radial artery one could be assured whether

the auscultatory signs indicated the true systolic pressure. After several observations made in this way a tactile estimate of blood-pressure was made at the radial artery. The patient was then made to stand at ease, the instrument was lifted to a higher support and the whole series of observations was repeated.

Anyone can convince himself that, in the great majority of cases, the maximum of blood-pressure moves up and down with the rhythm of the respiration. Nothing is easier than to determine the exact phase of the respiratory movement in which the first "pop" of the first phase is heard, to read the level of the mercury column corresponding to it and thus obtain the maximal blood-pressure. It is therefore astonishing to note the variety of views entertained by various observers concerning the point upon the respiratory curve which corresponds with the maximal blood-pressure.

Thomas Lewis,³² who summarizes the literature antedating his own work, explains the discrepancies as follows: "In man a deep intercostal inspiration, which is not prolonged, yields a pure fall of blood-pressure. A deep diaphragmatic inspiration, which is not prolonged, gives a pure rise of blood-pressure. The rise in blood-pressure in abdominal breathing is due to raised intra-abdominal pressure. It follows that many of the recorded inspiratory rises of blood-pressure in man are due to diaphragmatic breathing."

Erlanger and Festerling,³³ who used the graphic "oscillatory" method familiar in the instrument devised by the former, speak in no uncertain terms as follows: "The arterial blood-pressure falls during inspiration and rises during expiration whether the breathing is normal (slow or fast), abdominal or thoracic." Weyssse and Lutz³⁴ later reached the same conclusion with the use of Erlanger's sphygmomanometer.

Foley, Coblenz and Snyder³⁵ have carried out the only work, apparently, that closely followed the objects of the present research. These authors, however, instructed their subjects, mostly young men, to breathe deeply and slowly during the estimation of their blood-pressures. They accordingly obtained extraordinary differences in the values of their maximal blood-pressures dependent on respiratory movement. A quotation from their paper will serve to indicate in general the method and results I am attempting to describe. "During a decompression experiment the level at which the first few sounds are heard (or at which the period of sounds is first introduced) must be the level of the highest systolic pressure during a respiratory cycle. This may be called the *maximum respiratory systolic pressure*. When, upon further decompression, the sounds are constant for the first time throughout the whole of the

³² Jour. Physiol., 1908, xxxvii, 232.

³³ Loc. cit.

³⁴ Am. Jour. Physiol., 1913, xxxii, 477.

³⁵ Am. Jour. Physiol., 1916, xl, 554.

respiratory cycle the level of the lowest systolic pressure is reached. This pressure may be called the *minimum respiratory systolic pressure*." These authors habitually found the range between the highest and lowest systolic pressures in the same subject to reach the extraordinary values of 20 to 40 mm. Hg.

In my work care was taken that there should be no voluntary deepening of the breathing, and the average figures are much lower and their fluctuation would seem to have a diagnostic value.

Foley and his collaborators investigated also the respiratory variations of the diastolic blood-pressure, with the resulting conclusion that with deep breathing the ordinary pulse-pressure increased from 19 to 85 per cent. These authors found that the maximum systolic blood-pressure could correspond either with the inspiratory or expiratory phase of respiration, but that the more common result was inspiratory maximal blood-pressure.

My own findings in this particular agree most positively with those of Erlanger and Festerling,³⁶ that the maximal blood-pressure coincides with the phase of expiration, most commonly with the beginning of the expiratory pause. In several examples out of hundreds of observations there was no respiratory difference between the maximal pressures, and, in a few cases, there was a tendency for the maximal pressure to coincide with inspiration, but no positive records illustrating this condition could be obtained. As a possible explanation of the discrepancy between the findings of different authors, attention may be again directed to the occurrence of silent phases in the gamut of blood-pressure sounds which is particularly frequent in functional weakness of the circulation. When the first sound during decompression is heard at 110 mm. Hg., for example, while the radial pulse below the cuff can already be felt at 115 mm. Hg., it is obvious that the auscultatory finding is worthless as an index of maximal blood-pressure. Every conclusion as to the auscultatory systolic range of arterial pressure should be checked by the tactile evidence of the radial pulse.

Persons differ greatly in the respiratory range of maximal blood-pressure. Although the effect of breathing is primarily due to the rhythmic variation in the volume of blood accommodated by the lungs, it must not be supposed that this mechanical factor is the only one concerned. It is worth noting, however, that in patients subject to bronchial asthma the respiratory variations in maximal pressure are characteristically great, and this fact may be of diagnostic worth in estimating the bronchial component in certain syndromes, as that of hay fever. If decompression is carried out very slowly, pausing during one full respiration with every fall of 1 or 2 mm. in the mercury column, the first pops to be heard commonly occur about the end of expiration and, with falling pressure,

³⁶ Loc. cit.

gradually extend up the limbs of the respiratory curves (see Figs. 4 and 5) toward the crest which marks full inspiration. Decompression may proceed to the extent of but 1 to 3 mm. Hg. before the

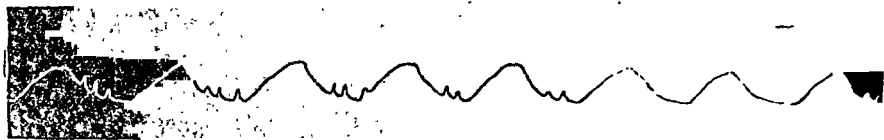


FIG. 1 *a*.—110 mm. Hg.

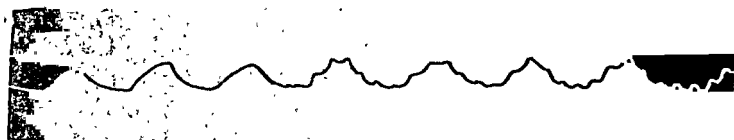


FIG. 1 *b*.—95 mm. Hg.

FIG. 1.—Tracing from a girl, aged twenty years, with chronic, stationary pulmonary tuberculosis. Cuff pressure in *a* is 110 mm. Hg. It is seen that a few pulse sounds are heard at the end of each expiration, then two respirations occur without arterial sounds: that is, the maximal systolic pressure had dropped temporarily below 110 mm. Hg. After various fluctuations the maximal pressure fell far, so that at 95 mm. (tracing *b*) still no arterial sounds were heard for a considerable period, then the pressure rose rather abruptly and pulsations are heard throughout the respiratory cycle.

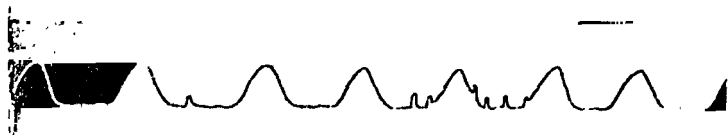


FIG. 2 *a*.—180 mm. Hg.

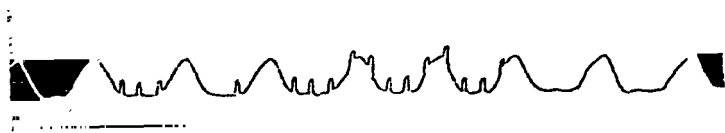


FIG. 2 *b*.—180 mm. Hg.



FIG. 2 *c*.—180 mm. Hg.

FIG. 2.—Case of compensated cardiovascular-renal hypertension in a woman, aged fifty-seven years. The cuff pressure is 180 mm. Hg. The respiratory and "vasomotor" variations of maximal systolic pressure are shown.

full succession of pulse sounds is heard throughout the respiratory cycle. Usually the mercury column must drop 5 mm. Hg. from its height at the first pop to that at which a full series of sounds is heard.



FIG. 3 a.—190 mm. Hg.



FIG. 3 b.—190 mm. Hg.

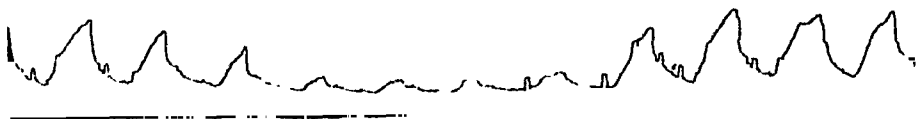


FIG. 3 c.—190 mm. Hg.

FIG. 3.—A physician, aged sixty-eight years, with marked hypertension without renal disease. The cuff pressure is 190 mm. Hg. The patient dozes while under observation and the amplitude of respiratory movement rhythmically varies. The subject's slumber seems deeper when his respiration is shallow. At these periods his systolic pressure has dropped below 190. Each series of more vigorous respirations is initiated by a strong heartbeat which raises the pressure over 190 mm. Hg. The tiny undulations of the respiratory curves are artefacts, due to transmission of cardiac pulsation to the chest wall.



FIG. 4 a.—95 mm. Hg.



FIG. 4 b.—100 mm. Hg.



FIG. 4 c.—105 mm. Hg.

FIG. 4.—Tracings from a healthy woman, aged thirty years. Tracing *a*, taken at 95 mm. Hg. pressure, shows regular pulsations throughout each respiratory curve; *b*, pressure 100 mm. Hg. and *c*, pressure 105 mm. Hg. are self-explanatory.

With normal breathing it is not uncommon to find the maximum and minimum respiratory systolic pressures to differ by 10 or even 20 mm. Hg. The difference is liable to be much more marked in the erect than in the recumbent posture. In such cases it becomes of practical importance to decide upon a criterion of systolic blood-pressure. Neither the maximal nor the minimal systolic pressure represents the truth. It has been my practice to take the minimum systolic pressure in estimating the pulse-pressure, though obviously the mean systolic pressure should be calculated in special cases. When we consider that the diastolic blood-pressure undergoes similar respiratory undulations, and that our clinical estimation of systolic and diastolic pressures cannot be made simultaneously, it is obvious, as stated in a preceding section, that determinations of the pulse-pressure are crude approximations of the truth.

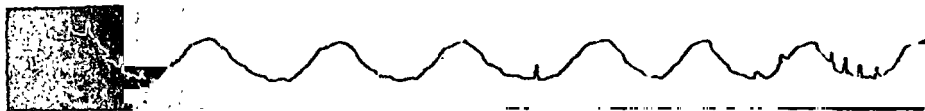


FIG. 5 a.—118 mm. Hg.



FIG. 5 b.—115 mm. Hg.



FIG. 5 c.—110 mm. Hg.

FIG. 5.—Normal medical student, aged twenty-two years. *a* (cuff pressure 118 mm. Hg.) shows how curiously the maximal pressure is elevated during one respiration. The tiny undulations in the first four respirations curves are artefacts; *b* is taken with cuff pressure at 115 and *c* at 110 mm. Hg.

It may be said that with care in palpating the radial artery it will be found that the respiratory range of systolic blood-pressure, so obvious by the auscultatory method, can be verified by the tactile procedure. It is worth noting that the amplitude of the oscillations in the mercury column is generally proportional to the loudness of the arterial sounds and to the size of the pulse at the wrist.

This subject will be allowed to rest with the observation that the respiratory changes of blood-pressure present a fallow field in clinical pathology that is well worth working.

VASOMOTOR AND OTHER SECONDARY VARIATIONS IN ARTERIAL BLOOD-PRESSURE. It remains to consider other variations of

systolic blood-pressure which cannot be due to respiratory movement, since their rhythm is slower.

The waves which they would make upon a blood-pressure tracing vary enormously in length from crest to crest, their period varying from a few seconds to many minutes. The amplitude of these waves, or distance between crest and trough, may easily indicate a range of pressure of 25 to 30 mm. Hg.

The depth of the waves is apt to be greatly exaggerated in the erect posture.

I am distinctly of the opinion that their prominence is a sign of physiological effort, and that they have a diagnostic worth, for they are most in evidence in a definite clinical type of cases. Perhaps the clearest characterization of this class would group its members as neurotics. They suffer from functional instability which makes sustained effort difficult and exhausting. The evidence indicates that the ebb and flow of energy which produces these waves is sometimes synchronous with the respiratory movements.

The waves in question can easily be detected by producing a cuff pressure somewhere within the range of systolic blood-pressure and holding the mercury column at that point. It will usually be perceived that more or less slowly alternating periods of sound and silence ensue. The depth of this secondary wave is determined by the distance on the mercury column between the highest maximum blood-pressure and that at which the auscultated sounds accompany each heartbeat. In a recent case the maximum blood-pressure was 125 mm. Hg., but, after the advent of fatigue standing, at 100 mm. Hg., the sounds rhythmically disappeared for periods of several seconds; at the same time the pulse failed at the wrist and the oscillations of the mercury column nearly ceased.

With our present knowledge the disposition is to explain these fluctuations of arterial pressure as due to rhythmic variations in the activity of the vasomotor nerve centers. The matter may not be so simple. In 1901 Bayliss³⁷ described rhythmic contractions and dilatations in the vessels of a pithed and perfused frog. The same author later proved that the muscular coats of living arteries definitely respond to variations of internal pressure, contracting with increase and relaxing with diminution of the stretching force.³⁸ There is also evidence, as pointed out by Lewis³⁹ as a new fact, that rhythmic variations in the amplitude of heartbeat, and consequently of systolic output, may cause great rhythmic changes in blood-pressure. An obvious cause of such cardiac variability may be found in mechanical impediments to movement of the heart. Thus a patient whose blood-pressure showed secondary waves of this kind of extraordinary amplitude had a few months before sur-

³⁷ Jour. Physiol., 1900-1901, xxvi, 21.

³⁸ W. M. Bayliss: Jour. Physiol., 1902, xxviii, 220.

³⁹ Loc. cit.

vived an attack of pneumonia, and when examined presented strong clinical evidence of the presence of pleuropericardial adhesions on the right side. Considering the frequency of this pathological sequence to thoracic disease and the marked effect which traction upon the pericardium has upon blood-pressure in the experimental animal, it is clear that in certain cases, at least, blood-pressure variations may have their origin in the heart itself.

A further source of extensive rhythmic and comparatively rapid variations in blood-pressure may possibly be found in fluctuations in the volume of the circulating fluid. The important work of Bogart, Underhill and Mendel⁴⁰ demonstrated that the tissue spaces provide a potential reservoir between which and the blood stream there may be rapid and extensive exchange of fluid. They found that "complete restoration of the original blood volume takes place within thirty minutes after the intravenous injection of a quantity of saline solution equal to the calculated blood volume of the animal. . . . The tissues act as a reservoir for this fluid. . . . The capacity of the tissues of rabbits to absorb fluid is approximately four times the normal blood volume of the animal."

Finally, another possible cause of rhythmic alterations in blood-pressure, though at present wholly theoretical, is potentially of the first importance; this is the viscosity of the blood. Its field of action may ere long include much of what we know as physiology.

After all is said, however, we must still hold the view that rhythmic variation, in the intensity of discharge from the vasomotor centers is the common cause of the longer waves in arterial blood-pressure.

GRAPHIC REPRESENTATION OF THE RELATIONS OF PULSE AND RESPIRATION. It is obviously desirable that objective evidence be offered for such assertions as have been made as to the relations of the primary or pulse wave to the secondary waves of systolic blood-pressure.

For this purpose graphic tracings were made of the respiratory movements of persons, usually in the recumbent posture, under investigation. A tambour of appropriate design was laid upon the chest and held in place by an encircling tape. The chamber of this instrument was joined by a rubber tube with that of a small recording tambour whose lever wrote upon a moving smoked surface. Ascent of the curve indicated inspiration and descent expiration. With the sphygmomanometer and stethoscope arranged as have been described, air-pressure within the cuff was raised until arterial sounds were obliterated, and then, with the eyes of the observer on the mercury column and the tube connecting the tambours held between a thumb and finger, decompression was slowly effected. and as each arterial sound came through the tube was sharply

⁴⁰ Am. Jour. Physiol., 1916, xli, 189.

pinched, thus marking upon the respiratory curve an abrupt elevation for each sound. The method is open to obvious objections, but it sufficiently accomplishes the object in view.

SUMMARY AND CONCLUSIONS.

1. This is an essay to demonstrate anew the clinical importance of tests to determine the quantitative range as contrasted with the qualitative perversion of physiological functions.

2. Changing the position of the body from the recumbent to the erect posture throws upon the organs of circulation a definite strain determined by the gravitation of blood. The physiological reaction to this strain is manifested, aside from the heart-rate, by modification of the blood-pressures. Excessive fall of systolic blood-pressure in the erect posture indicates weakness of vasomotor control. Excessive rise of diastolic pressure denotes vascular spasm and abnormal effort. Each results in abnormal depression of pulse-pressure, the maintenance of which to a certain magnitude is necessary to proper nutrition of the brain and other tissues.

3. The blood stasis manifested by fall of systolic pressure may be measurably counteracted by the support of an abdominal belt. The diastolic blood-pressure represents the head of power available for the coronary circulation. When that pressure is high and the heartbeat vigorous we have the conditions of cardiac hypertrophy. When it is high and the heartbeat is feeble the result is probably simple dilatation. Fainting and sudden death are probably the results of critical lowering of diastolic blood-pressure. Abnormal elevation of diastolic pressure is the usual cause of depression of pulse-pressure in the erect posture. It probably signifies lack of contractile vigor in the ventricles. Small doses of digitalis may cause clinical improvement in such cases.

4. The manifestation of chronic circulation deficiency is probably usually founded upon toxemia from focal infection or upon a larval form of tuberculosis, here denominated "occult tuberculosis."

5. It is suggested that estimations should be made under different conditions of the velocity of the blood-current, as represented by the product obtained in multiplying the pulse-pressure by the pulse-rate.

6. Attention is called to the great frequency with which, in persons suffering from weakness of the circulation, the pulse sounds revealed by the auscultatory method are enfeebled or absent. This failure has some relation to venous congestion below the cuff.

7. The maximal arterial blood-pressure is more or less markedly affected by respiratory movement. According to these observations it is highest during expiration and lowest during inspiration. The difference between the maxima taken in the two phases of respiration may reach, with quiet breathing, anywhere between 0 and 20 mm.

Hg. Perhaps the average difference between the "maximum systolic" and the "minimum systolic" blood-pressure is 5 mm. Hg.

8. Besides the influence of respiratory movement the systolic blood-pressure is subject to another secondary cause of fluctuation. This probably consists in more or less slow variations in the intensity of vasomotor tone. The height of maximal pressure may apparently change 30 mm. Hg. within a minute from this cause. The occurrence and range of such pressure variations seem to be determined by the vital reaction of the subject to strain, and are presumably of value to clinical diagnosis.

NOTE ON THE VITAL CAPACITY OF THE LUNGS AND THE CARBON DIOXIDE COMBINING CAPACITY OF THE BLOOD IN CASES OF "EFFORT SYNDROME."

BY FRANK D. ADAMS, M.D., FIRST LIEUT., M.C., U.S.A.,
WASHINGTON, D. C.

AND

CYRUS C. STURGIS, M.D., FIRST LIEUT., M.C., U.S.A.,
PENDLETON, OREGON.

(From the Cardiovascular Division of the Medical Service, U. S. Army General Hospital No. 9, Lakewood, N. J.)

I. THE VITAL CAPACITY OF THE LUNGS. The majority of the patients at U. S. Army General Hospital No. 9 having the symptom-complex known as the "irritable heart of soldiers," or "effort syndrome," complained of shortness of breath following varying amounts of exercise. Since it has been shown that in cases of organic heart disease the tendency to dyspnea on exertion corresponds closely to the degree of the decrease of the vital capacity of the lungs below the normal, a group of 100 soldiers with "irritable heart" were studied to determine whether an interference with pulmonary ventilation depending on such a cause might be a factor in producing their dyspnea.

The vital capacity was determined in each instance by having the patient exhale into a small spirometer from the point of maximum forced inspiration to that of maximum forced expiration. In each instance the individual was allowed three or more trials until the observer was satisfied that the maximum point had been reached and the highest reading was considered as the subject's vital capacity. A few individuals, whose lack of effort or coöperation made it clear that the results in their cases did not represent their true vital capacity, are not included in the series. The readings were compared with the normal figures for individuals of approxi-

mately the same height and the results expressed in percentage of the appropriate normal.

The normal standards used were those given by Peabody and Wentworth.¹ They are based on the relationship between vital capacity of the lungs and height, as is shown in the following table:

	Height (cm.).	Vital capacity (c.c.).
Group I	182.5 and above	5100
Group II	173.5-182.5	4800
Group III	below 173.5	4000

In a study of 96 normal males, Peabody and Wentworth found that all but one had a vital capacity of at least 90 per cent. of these standards. Patients with heart disease who developed dyspnea on moderately severe exertion were usually found to have a vital capacity between 50 and 90 per cent. of the normal, and the vital capacity was lowest in those with the most marked tendency to dyspnea. The results of the present investigation of soldiers with "irritable heart" is shown in the following table:

Vital capacity. Per cent. of normal.	Number.
110 or over	9
105 to 109	9
100 to 104	17
95 to 99	18
90 to 94	27
85 to 89	13
80 to 84	7

It will be seen that 80 per cent. of these cases had a vital capacity of 90 per cent. of the normal or more and that 93 per cent. had a vital capacity of at least 85 per cent. of the normal standard. Thus a small proportion of the patients with "irritable heart" have a vital capacity which falls below what have been accepted as the normal standards, but neither the number of cases nor the degree of decrease of vital capacity are sufficient to indicate that the tendency to dyspnea in these patients is in any way dependent on a diminished vital capacity of the lungs. Tests of general muscular strength showed no relation between the muscular development and the vital capacity of the lungs.

II. THE CARBON DIOXIDE COMBINING CAPACITY OF THE BLOOD PLASMA. Dyspnea in patients with "irritable heart" has been attributed by Lewis and his co-workers² to a deficiency of buffer salts in the blood. According to them the production of acids as a result of exercise causes change in the reaction of the blood, with consequent stimulation of the respiratory center.

¹ Arch. Int. Med., 1917, xx, 449.

² Lewis, Cotton, Bancroft, Milroy, Dufton and Parsons: British Med. Jour., 1916, ii, 517.

"Shortness of breath" on exertion was an almost constant complaint of the patients with "irritable heart" as observed at this hospital, but the type of patients differed somewhat from those studied by Lewis, inasmuch as in most cases seen here the symptoms had been present for a considerable length of time in civilian life and the condition was only intensified by their entrance into the army. However, a few cases were studied whose symptoms were of recent development following the physical and mental strain of military service. The dyspnea in all of these cases was most marked on exertion and rarely seen at rest, except under conditions of nervous strain.

In order to determine whether a diminished alkalinity of the blood played a role in the production of dyspnea in patients with "irritable heart," as seen at this hospital, a study was made of the carbon dioxide combining capacity of the blood according to the method of Van Slyke.³ By this method the carbon dioxide bound as bicarbonate in the blood plasma is determined and the results given in volume percentage. The normal varies from 53 to 77 volume per cent., while figures below 50 per cent. in adults indicate an acidosis, and symptoms of acid intoxication usually appear with a fall below 30 per cent. All observations were made on patients at rest and at least eight hours after the last meal.

Observations were made on fifty-four cases, and the carbon dioxide chemically bound as bicarbonate was found to fall within normal limits in all instances. Since, therefore, the carbon dioxide combining capacity of the blood is normal there is no indication that a decrease in the buffer salts of the blood is a factor in the production of dyspnea in patients with "irritable heart," as seen at this hospital.

NOTE.—These studies were carried out under the direction of Major Francis W. Peabody, M.C., and Capt. Bertnard Smith, M.C.

STUDIES OF CASES OF "EFFORT SYNDROME" WITH MEASURED WORK.

By THOMAS McC. MABON, M.D., FIRST LIEUT., M.C., U.S.A.,
PITTSBURGH, PENNSYLVANIA.

(From the Cardiovascular Division of the Medical Service, U. S. Army General Hospital No. 9, Lakewood, New Jersey.)

As a method of testing the functional efficiency of the heart muscle, Barringer¹ has suggested the study of the blood-pressure

³ Jour. Biol. Chem., 1917, xxx, 347.

¹ Arch. Int. Med., 1916, xvii, 363; Ibid., 1917, xx, 829.

changes after periods of severe exercise. A moderate amount of work is typically followed by a rise of blood-pressure of short duration and then by a fall to the normal again. When, however, the work is sufficient to overtax the heart, it is said that the immediate rise of blood-pressure is followed by a further "delayed" rise at a period of fifty to ninety seconds after the cessation of work. The observations reported here were undertaken primarily to find out whether any such response, which might indicate a myocardial weakness, would be found in soldiers who gave the clinical picture of the so-called "effort syndrome," and the method used is based on that devised by Barringer.

Pulse counts and systolic blood-pressure determinations were made before and after each exercise period, with the subject in the erect posture. Work was furnished by full extension from the shoulder of two five-pound dumb-bells. Extension and return occupied one second each and the rhythm was maintained by a metronome. The subjects were instructed and encouraged to exercise with the dumb-bells until they were completely fatigued, and three periods of work were performed with rest periods of five minutes interpolated between them. At the cessation of the work periods the blood-pressure was read by the auscultation method with a Riva-Rocci type of sphygmomanometer. The systolic blood-pressure was first taken ten seconds after the work stopped, then twenty seconds later and afterward at intervals of thirty seconds for a total period of three minutes following cessation of work. The pulse-rate was counted by another observer for fifteen seconds, beginning ten seconds after the exercise stopped, and thereafter for fifteen seconds at half-minute intervals over a period of three minutes.

Observations of the systolic blood-pressure and the pulse-rate after each of three successive periods of work were made on 50 patients with "effort syndrome" and on 11 healthy enlisted men of the medical detachment. Most of the patients had symptoms of long standing, antedating their military service by many years. The total amount of work done in the three periods by the normal soldiers varied between 6000 and 12,000 foot-pounds, five of them doing over 10,000 foot-pounds. The majority of the patients were only able to perform considerably smaller amounts of work, and for convenience they may be divided into groups depending on the total amount of work done. Thus 5 patients did only between 2000 and 3000 foot-pounds; 10 patients did between 3000 and 4000 foot-pounds; 17 did between 4000 and 5000 foot-pounds; 10 did between 5000 and 6000 foot-pounds; 8 between 6000 and 11,000 foot-pounds. Of the latter group only one subject performed over 10,000 foot-pounds of work.

In Table I there is presented an analysis of the average pulse reactions for each group of subjects. Under the heading "Rest" the pulse-rate before exercise is given, and in the three following

columns in each period appear the pulse-rate 10 seconds, 120 seconds and 180 seconds after stopping exercise. It should be remembered that in each period the subject was urged to do the maximum amount of work of which he was capable, and the interval between the periods of work was five minutes. It will be noted that the pulse-rate at rest was always higher for the patients than for the normals, and that in each succeeding rest period the pulse-rate of the patients tends to increase slightly more than it does in the normals. On the other hand the immediate increase in pulse-rate after exercise, as shown by the count taken ten seconds after stopping, is by no means constantly greater in the patients than in the normals. At the end of three minutes the pulse-rate of the patients had returned to its value at rest nearly as completely as had that of the normal subjects. The same is true of the pulse-rate taken two minutes after exercise stopped. There is thus no definite evidence that the pulse returns to its basal level more slowly in this group of patients with "effort syndrome" than it does in normal persons after exercise.

TABLE I.—PULSE-RATES BEFORE AND AFTER EXERCISE
(AVERAGES FOR EACH GROUP).

Group.	No. of cases.	Work, foot-pounds.	Pulse-rates.											
			Period I.				Period II.				Period III.			
			Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.	Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.	Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.
Normals	11	6-12000	79	111	85	83	84	115	87	80	80	125	92	86
I . .	8	6-11000	94	136	119	111	110	130	119	114	112	132	119	116
II . .	10	5-6000	84	107	96	95	94	114	105	100	100	116	104	100
III . .	17	4-5000	98	123	109	104	103	125	112	108	107	128	114	109
IV . .	10	3-4000	97	122	108	105	105	122	111	107	107	122	108	105
V . .	5	2-3000	87	110	97	98	96	111	99	97	97	111	98	96

Table II presents a similar analysis of the changes in systolic blood-pressure after exercise. The blood-pressure at rest before the first exercise period is somewhat higher in the three groups of patients doing the largest amounts of work than it is in the normals. The rise in blood-pressure immediately after exercise is distinctly less in the patients than in the normals, and it seems probable that this depends on the fact that they did less work. The return of the blood-pressure to the figures at which it was before exercise is as complete and as rapid among the patients as among the normals. There is a general tendency in the patients for the blood-pressure to assume a lower level at rest after each succeeding exercise period, and this is not noticeable in the normal subjects.

TABLE II.—SYSTOLIC BLOOD-PRESSURE BEFORE AND AFTER EXERCISE
(AVERAGES FOR EACH GROUP).

Group.	No. of cases.	Work, foot-pounds.	Systolic blood-pressure (mm. mercury).											
			Period I.				Period II.				Period III.			
			Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.	Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.	Rest.	10 seconds after work.	120 seconds after work.	180 seconds after work.
Normals	11	6-12000	121	133	121	120	121	127	120	119	120	130	121	119
I . .	8	6-11000	135	138	134	131	128	135	128	126	124	130	122	121
II . .	10	5-6000	127	130	126	125	124	128	123	122	121	126	121	120
III . .	17	4-5000	130	136	131	128	128	132	127	126	124	128	123	122
IV . .	10	3-4000	123	128	124	123	122	129	121	118	118	126	120	118
V . .	5	2-3000	116	123	121	120	120	122	115	116	115	118	113	112

In a number of the patients slight "delayed rises" in blood-pressure were observed from thirty to ninety seconds after stopping the exercise. These were almost invariably very small (from 2 to 6 mm.) and occurred after only one or two of the periods of exercise. Sometimes they appeared after the first period and not after the second or third, or after the first and second periods and not after the third. On the whole, they were less frequent after the third period. There were no "delayed rises" in the blood-pressure of significant degree which appeared with any constancy or which tended to increase with additional amounts of work. The only instance in which a "delayed rise" occurred after all three periods, and was of sufficient degree to have a possible significance was in a normal subject in whom rises of 8, 17 and 8 mm. were observed after each of the three exercise periods. Thus in spite of making the subjects do the maximum amount of work of which they were capable, "delayed rise" of blood-pressure was only rarely and inconstantly observed, and it was almost always of so slight a degree as not to have any clinical significance. As far as this phenomenon goes there is no evidence indicating a myocardial insufficiency in the patients with "effort syndromes" who were studied.

The most striking feature of this investigation was that only a small percentage of the patients were able to do anything like the amount of work which the normal subjects could do. Two elements seemed to be at the bottom of this. In the first place the patients appeared to lack the energy and "drive" to force themselves to continue after they became tired, and in the second place they showed a definite weakness of the skeletal muscles. That this latter is important is shown by Table III, in which the amount of work done in these exercise tests is compared for each group with the average strength-weight ratio as determined by the

"spring balance" method of Dr. E. G. Martin. The figure given for the normal strength-weight ratio is that found by Capt. Bernard Smith from tests made on a large series of normal soldiers,² and all the other strength tests were also made by him. Capt. Smith's observations show that poor muscular development is a prominent feature in many cases of "effort syndrome" with long-standing symptoms. It is much less evident in the cases whose symptoms have lasted only a short time, and where they are directly dependent on the physical and nervous strain of the military experience.

TABLE III.

Group.	Work, foot-pounds.	Strength, weight ratio.
Normals	6-12000	25.6
I	6-11000	24.4
II	5-6000	20.5
III	4-5000	15.7
IV	3-4000	11.0
V	2-3000	11.0

It will be seen that there is a very close correspondence between the average strength of the skeletal muscular system and the amount of work done in the exercise periods. When the strength tests of the various individuals are studied it is found that certain exceptions to this arise. This is most definitely seen in Group V, in which three of the subjects had strength-weight ratios of 6.7, 7.5 and 7.9, while in two others they were 14.1 and 18.9. These men were both better developed than the others in the group, but they were extremely neurotic and completely lacking in energy. It was quite impossible to make them undertake any continuous exertion, as they immediately began to complain of fatigue, one of the cardinal symptoms of the "effort syndrome." The fact that their strength tests were better than those of the others in the group is accounted for by the fact that the determination of the strength test depends on a series of single pulls against the spring balance and does not require continued exertion. This lack of energy and "push," which may amount to what may be termed "asthenia," is a part of the neurotic constitution which underlies most cases of "effort syndrome." In some instances it seems to be due to a fear of bringing on uncomfortable symptoms, and in some, particularly in those who believe they have a "weak heart," to a fear of injuring themselves seriously; but in others it seems to be due to the inherent lack of force of character which manifests itself in so many of their other reactions toward life. It is often the underlying factor which has led to their poor physical development, for they have never put themselves through a hard course of physical training. The "fatigue" of which these patients complain so frequently, and of which their poor per-

² The Possibilities of Physical Development in Cases of Effort Syndrome by Means of Graded Exercises. (To be published.)

formance of work, as illustrated in the observations just described, is a manifestation, is a complex symptom. In how far it is dependent in a given case, on a neuropathic state and in how far on weakness of skeletal musculature, it is often impossible to determine. It seems clear, however, that in cases of "effort syndrome" in which the symptoms have been present for many years, as they had been in most of the patients at Lakewood, both factors are to be considered. It is probable that a vicious circle is easily established and that each factor reacts detrimentally on the other.

CONCLUSIONS. A study was undertaken of the changes in pulse-rate and blood-pressure taking place in fifty patients with "effort syndrome" after the hardest exercise which they could be induced to perform. These were for the most part patients with symptoms of many years' duration. The amount of work which they could do before becoming fatigued was much less than was done by normal controls. The pulse-rate at rest was higher than in the normals, but the rise after exercise and the time for return of the pulse-rate to its resting value were not definitely abnormal. No "delayed rise" of blood-pressure suggesting myocardial inefficiency was observed. The amount of work which the subjects were able to perform usually corresponded closely to their physical strength as determined by tests of the skeletal muscles, and this indicates that lack of development of the skeletal muscular system is a factor to be considered in the cause of the fatigue following slight exertion in certain types of cases of "effort syndrome."

THE POSITION OF THE ARM IN BLOOD-PRESSURE MEASUREMENTS.

BY MORRIS H. KAHN, M.D.,

CHIEF OF CLINIC IN CARDIOVASCULAR DISEASES, MOUNT SINAI HOSPITAL DISPENSARY;
ASSISTANT, CARDIOGRAPHIC LABORATORY, MOUNT SINAI HOSPITAL,
NEW YORK CITY.

BLOOD-PRESSURE readings should be obtained with the patient's arm at the side of his chest, as the normal reading varies considerably with the arm in different positions. This holds for the seated, the standing and the recumbent postures.

Changing the position of the arm, as in elevating the elbow, produces changes in the blood-pressure of the arm probably as the result of both vasomotor and hydrostatic effects upon the column of blood. Leonard Hill has shown there exists a difference between the pressures in two arteries placed at different levels in relation to the heart. Thus the two arms in different positions and the arm and leg readings would differ by the hydrostatic pressure of the column of blood which separates the points of measurement.

The following studies were made upon men between the ages of twenty and thirty years, with a view to determine the effect upon the blood-pressure readings of raising the arm to various angles from the side of the body. The following groups of cases were examined:

Normal heart	27 cases
Neurocirculatory asthenia	13 "
Thyrototoxic and exophthalmic goitre	7 "
Simple tachycardia	5 "
Paroxysmal tachycardia	5 "
Nephritic hypertension	5 "
Mitral regurgitation	2 "
Aortic regurgitation	3 "

METHOD. The patient was comfortably seated, the arm at his side and the elbow and forearm supported. The systolic and diastolic pressures were taken by the Korotkow method, using a wide cuff. The highest level of armlet pressure at which sound was audible was read as the systolic pressure. The level of armlet pressure at which all sound suddenly declined was taken as the index of diastolic pressure. The arm was then raised to an angle of 45 degrees from the side of the chest and the readings again recorded. This was repeated for 90, 135 and 180 degrees respectively, while the patient's elbow was supported by an assistant.

Table I presents the form in which our data were collected, with a list of characteristic readings from the normal cases.

TABLE I.

	Syst.	Dias.	S.	D.	S.	D.	S.	D.	S.	D.	S.	D.
Blood-pressure, seated	118	80	109	65	112	68	110	68	120	70	100	75
Arm elevated 45 degrees	108	68	112	50	106	65	102	58	105	70	104	75
" " 90 "	104	64	110	54	110	56	96	50	98	55	100	70
" " 135 "	92	60	102	30	76	52	76	40	86	50	80	60
" " 180 "	90	50	82	0	66	45	35	0	68	48	80	48
	Case I.		Case II.		Case III.				Case IV.			

BLOOD-PRESSURE READINGS IN THE NORMAL CASES. The effect of the position of the arm on blood-pressure readings was studied in 27 cases of normal heart; in all 47 series of tests were made. The differences were fairly constant for the individual. Fig. 1 shows graphically and very clearly the average of the entire series of figures from this group. The systolic pressure fell an average of 8 mm. of mercury in the first 45 degrees of elevation, 6 mm. more to 90 degrees, 14 mm. more to 135 degrees and 25 mm. on raising the arm vertically; a total fall of 53 mm. in the systolic pressure in 180 degrees of elevation. The diastolic pressure shows a parallel curve, slightly less than the systolic, with a total fall of 42 mm. On lowering the elbow to the previous position the pressure promptly

returns to its former reading. Table II presents a list of characteristic figures as they were calculated from the normal group of cases.

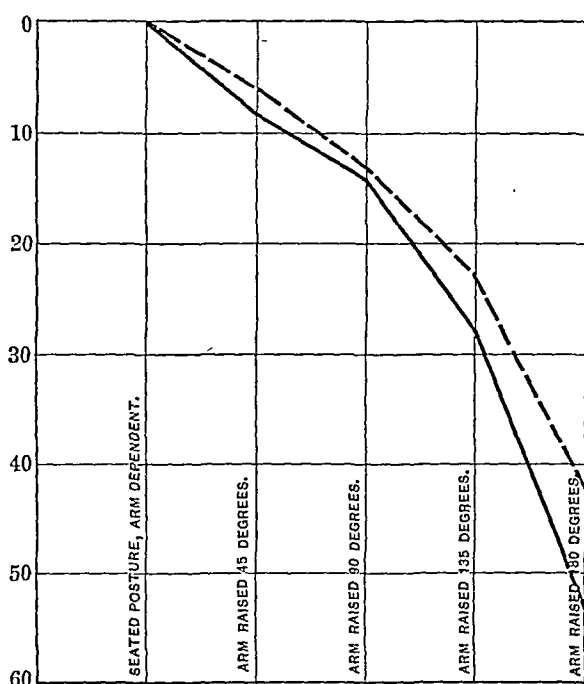


FIG. 1.—Effect of the position of the arm on blood-pressure measurements: Average in twenty-seven cases with normal cardiovascular conditions.

TABLE II.

Elevation of 45 degrees.		From 45 to 90 degrees.		From 90 to 135 degrees.		From 135 to 180 degrees.	
Syst.	Diast.	Syst.	Diast.	Syst.	Diast.	Syst.	Diast.
- 2	-16	+ 2	-20	-26	-40	-14	- 0
-16	- 2	- 2	-12	-14	-20	-14	-40
- 2	- 0	- 6	- 8	-24	- 6	- 9	-15
- 8	- 4	- 2	- 4	- 6	-10	-24	- 6
-10	- 0	-20	-30	- 5	- 5	- 0	- 2
-15	- 0	- 7	-15	-12	- 5	-18	-12
+ 4	- 0	- 4	- 5	-20	-10	- 0	-86
- 1	-10	- 0	- 6	-18	-20	-21	-56
- 8	-14	- 0	-10	-16	- 4	- 8	-10
-10	- 8	-14	-14	- 4	-10	-10	-11
- 6	- 3	- 6	-13	-24	- 7	-10	-40
- 8	-10	- 6	- 8	-20	-10	-36	-12

POSITION OF THE ARM AND BLOOD-PRESSURE READINGS IN NEURO-CIRCULATORY ASTHENIA. Thirteen cases of neurocirculatory asthenia were studied in which 21 series of arm tests were made. The curve in this condition is distinctly exaggerated over the normal (Fig. 2). The change of pressure, both systolic and diastolic, is more precipitate, 15 mm. up to 90 degrees elevation and 52 mm. more up to 180 degrees, a total fall of 67 mm. systolic pressure in 180 degrees elevation of the arm and of 50 mm. diastolic pressure.

This is significant and is probably the result of the vasomotor instability in these cases. It is therefore to be observed that it is not alone the hydrostatic pressure that factors in this difference, but the state of the vasomotor support as well. It was in these cases that an occasional rise of pressure occurred upon elevating the arm, synchronous with a sudden increase of pulse-rate. These were not usual and only transient, and depended probably upon the nervous instability so characteristic of this malady. In a few cases the sounds were audible, with the arm in the elevated position without inflating the cuff.

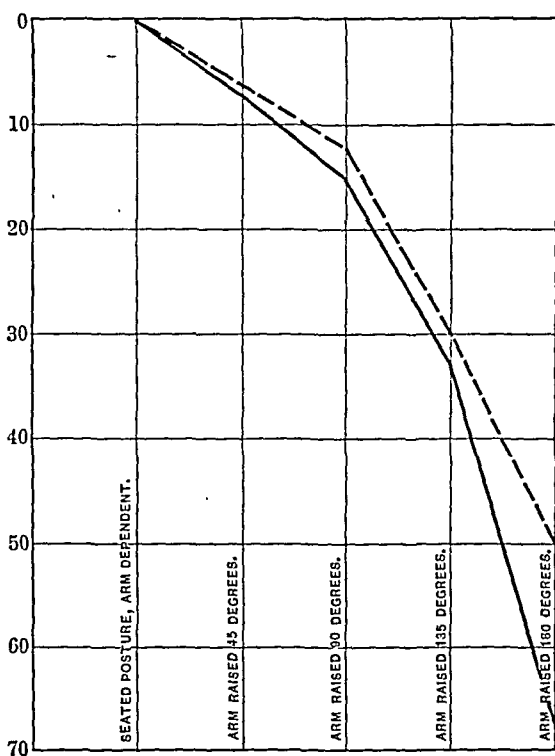


FIG. 2.—Effect of the position of the arm on blood-pressure measurements: Average in thirteen cases of neurocirculatory asthenia.

IN THYROTOXIC CASES AND EXOPHTHALMIC GOITRE. Still more striking changes of blood-pressure readings were obtained in the cases of exophthalmic goitre and thyrotoxic heart. Ten series of tests were made in the 7 cases observed. The diminution of systolic pressure on raising the arm was as follows: 12 mm. in 45 degrees, 9 mm. more to 90 degrees, 13 mm. more to 135 degrees and finally 50 mm. in the last angle. That is, a total of 84 mm. of mercury systolic pressure was lost by elevating the arm to 180 degrees (Fig. 3). In these cases the systolic sound was often audible at 0 pressure, with the arm in the elevated position.

In the groups thus far observed the amount of fall of pressure progressively increased with the elevation of the arm.

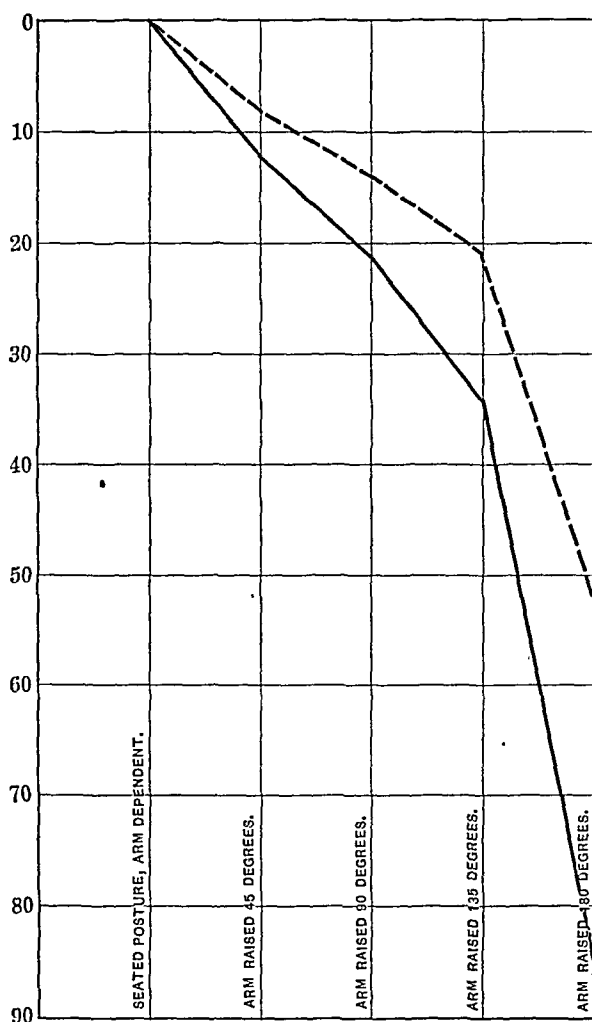


FIG. 3.—Effect of the position of the arm on blood-pressure measurements: Average in seven cases of hyperthyroidism and exophthalmic goitre.

IN CASES OF NEPHRITIC HYPERTENSION. In 5 cases of nephritic hypertension the characteristic feature was the blood-pressure maintained high despite elevation of the arm. In the previous groups we note that the fall of pressures increases as the arm is raised. In the group of hypertension cases, on the contrary, whatever fall takes place occurs at first; thus 9 mm. up to 45 degrees elevation, 6 mm. more up to 90 degrees, 6 more to 135 degrees and only 2 mm. finally; a total fall of only 23 mm. of mercury (Fig. 4).

That arterial hypertonus is an important factor in the high blood-pressure readings obtained in nephritis was repeatedly emphasized by Russell. Janeway and Park also found that the contraction of the arterial muscle is a definite factor in influencing its compressi-

bility, and therefore a positive factor in blood-pressure readings. Our findings in the cases of hypertension indicate that the hyper-

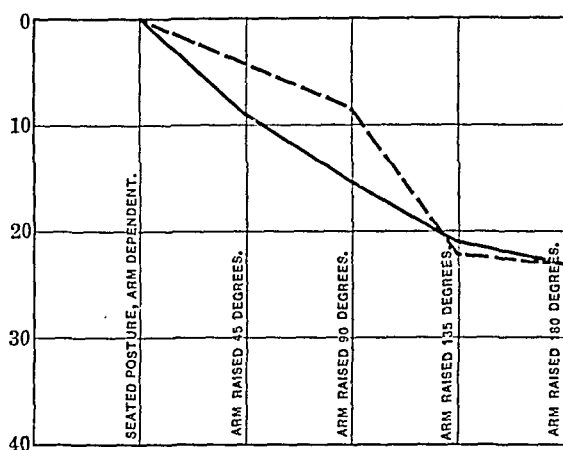


FIG. 4.—Effect of the position of the arm on blood-pressure measurements: Average in five cases of parenchymatous nephritis with hypertension.

tonus of the artery is maintained in varying positions of the arm, and is therefore an important cause of the maintained high pressure when the arm is elevated.

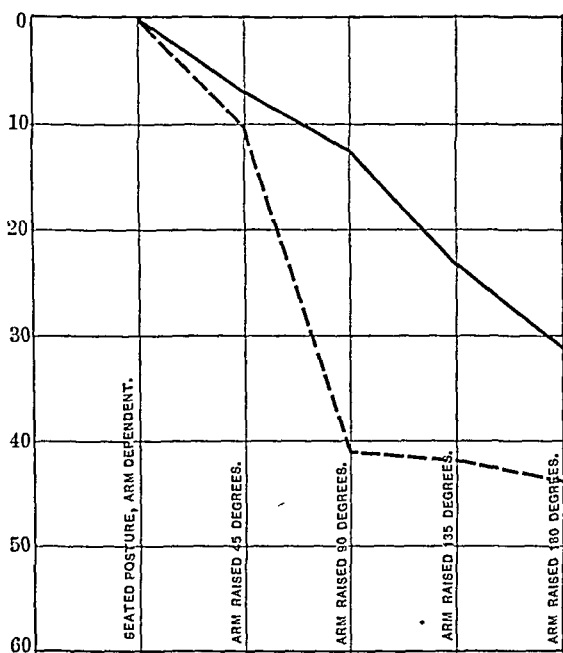


FIG. 5.—Effect of the position of the arm on blood-pressure measurements: Average in three cases of aortic regurgitation.

SIMPLE AND PAROXYSMAL TACHYCARDIA. In the 5 cases of simple tachycardia and the 5 cases of paroxysmal tachycardia a total of

fifteen tests were made. The difference of behavior of these cases from the normal is not marked. Elevation of the arm caused less of a fall of pressure in these cases than in the normal. We may assume this as natural, these cases showing slightly lower blood-pressure than normal.

IN ENDOCARDITIS. The same holds for two cases of compensated mitral regurgitation, in which four tests were made. The curve approximates the normal.

But aortic regurgitation seems to give a characteristic fall of pressure on elevating the arm. The diastolic pressure falls more than the systolic and more promptly than normally, accomplishing its main reduction up 90 degrees of elevation (Fig. 5). It is in this condition that there exists a marked difference between the arm and leg readings.

CONCLUSIONS. 1. Tests were made to note the effect of raising the arm upon auscultatory blood-pressure readings. Groups of cases were studied, including the normal, neurocirculatory asthenia, thyrotoxic conditions, tachycardia, nephritic hypertension and endocarditis.

2. The normal effect is a progressive fall of the systolic and diastolic pressure readings as the arm is raised upward; the amount of fall increases with the elevation.

3. The fall of pressures is more marked than normal in cases of neurocirculatory asthenia and is most precipitate in cases of hyperthyroidism and exophthalmic goitre.

4. The pressure yielding very little to elevation of the arm is a characteristic feature in nephritic hypertension.

5. In aortic regurgitation the diastolic pressure falls more steeply than the systolic, and its main reduction occurs up to 90 degrees elevation.

6. The graphic curves suggest a diagnostic import to the findings.

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FUNCTIONAL DIAGNOSIS OF POLYGLANDULAR DISEASE IN ACROMEGALY AND OTHER DISTURBANCES OF THE HYPOPHYSIS.

By C. P. HOWARD, M.D.,

IOWA CITY, IOWA.

(From the Medical Clinic, University Hospital, State University of Iowa.)

THE unusual opportunity afforded by the admission of 5 cases of hypophyseal disease to our medical clinic in the course of a few weeks was the stimulus for the work. Whereas in the previous 6000 medical admissions there were 11 cases (0.18 per cent.) we were suddenly confronted with these 5 cases. One case studied in 1914 has been added to the 5 recent cases.

As neither time nor space will permit a detailed history of these 6 cases we will content ourselves with a short summary of each case.

CASE I.—J. J., aged thirty-one years; farmer; not referred. Admitted December 23, 1914. Clinical No. 1814.

Summary. Acromegaly: round-cell sarcoma of pituitary gland. Symptoms first of hyperpituitarism, followed later by hypopituitarism; characteristic changes in acra; somnolence; polyphagia; optic atrophy and divergent strabismus; sugar tolerance increased; sella turcica enormously enlarged; trans-sphenoidal operation attempted December 28, 1914, but interrupted because of patient's condition; death three months later, with symptoms of right-sided hemiplegia; autopsy revealed an enormous pituitary tumor, with marked cerebral compression; atrophy of islands of Langerhans; atrophy of testes; slight cystic degeneration of the thyroid gland.

The adrenalin conjunctival test was strongly positive for adrenal insufficiency, while both subcutaneous tests spoke for normal function. The pituitrin conjunctival and both subcutaneous tests suggested a hypopituitarism.

CASE II.—Mrs. A. W., aged fifty-two years, female; referred by Dr. Cretzmeyer, Algona, Iowa. Admitted January 10, 1919. Clinical No. 5808.

Summary. Acromegaly; hyperpituitarism; amenorrhea at thirty-nine years; severe frontal headaches since forty-eighth year, followed by failure of vision, enlargement of head, hands and feet, profuse night-sweats; typical facies; acra characteristic; hypertrophy of genitalia; fundi negative; sella turcica enlarged; slight glycosuria, with much decrease in sugar tolerance; normal renal function. Adrenalin conjunctival and subcutaneous tests indicate hypofunction of adrenals; pituitrin tests doubtful; posterior lobe caused subjective improvement.

CASE III.—Mrs. O. H., aged forty-seven years; not referred; Clinton, Iowa. Admitted March 8, 1919. Clinical No. 6009.

Summary. Acromegaly; hyperpituitarism; symptoms for eight years; typical facies; slight goitre; acra much enlarged; divergent strabismus; greatly enlarged sella turcica; glycosuria; hyperglycemia; adrenalin conjunctival test spoke for a normal and the subcutaneous tests for a hypofunction of adrenals. The pituitrin conjunctival test was markedly positive, while of the subcutaneous tests, the blood-pressure one was normal and the blood picture within possible normal limits.

CASE IV.—James W. R., aged twenty-nine years; linotype operator; referred by Dr. Fred Bailey, Cedar Rapids, Iowa. Admitted February 27, 1919. Clinical No. 5974.

Summary. Sarcoma of the occipitoparietal lobe; no localizing symptoms; diagnosis of hyperpituitarism from tumor of hypophysis made because of occipital and temporal headache, double papilledema, distorted sella turcica and decreased sugar tolerance; transphenoidal decompression, followed in two weeks by death; autopsy revealed flattening of hypophysis from greatly increased intracranial pressure, which had thinned out even the sella; microscopically, hyperemia of the entire hypophysis, with hemorrhage by diapedesis into pars nervosa. Adrenalin conjunctival test and one of the subcutaneous tests spoke for hypofunction of adrenals. All three pituitrin tests were normal.

CASE V.—Miss L. K., aged sixteen years; not referred. Admitted March 15, 1919. Clinical No. 6036.

Summary. Dystrophia adiposogenitalis; Froehlich syndrome; malaria and typhoid fevers in childhood; periodical diplopia, with headache, nausea and vomiting; amenorrhea at fourteenth year, followed by enlargement of breasts and rapid gain in weight of forty-two pounds; nycturia; facies and figure of hypopituitarism; convergent strabismus; transient glycosuria and marked decrease of sugar tolerance; sella turcica small; adrenalin conjunctival and subcutaneous tests spoke for normal adrenal function. The pituitrin conjunctival and subcutaneous tests were also within normal limits.

CASE VI.—Mrs. M. L., aged thirty-four years; referred by Dr. W. W. Daut, Muscatine, Iowa. Admitted May 5, 1919. Clinical No. 6225.

Summary. Dystrophia adiposogenitalis; Froehlich syndrome; obesity; glycosuria; marked family history of obesity on maternal side and in sisters; amenorrhea; obesity; headaches; nycturia; glycosuria; signs of tertiary lues and old pelvic cellulitis; Wassermann negative; normal facies; normal hair except for hirsuties over face; slender extremities; sella turcica not enlarged; adrenalin conjunctival and subcutaneous blood-picture tests spoke for normal function of adrenals. The diminution of 14 mm. in systolic pressure cannot be explained. The conjunctival and subcutaneous pituitrin tests were normal.

A paper by Karl Csépai¹ which appeared in 1914 described a comparatively new method of investigation of the diseases of the endocrine glands, and has been applied to our six cases, which form the material of this paper.

It seems hardly necessary to state that the determination of the sugar tolerance is as yet the most accurate and only scientific method for an estimation of the activity of the internal secretion of the hypophysis, thyroid gland and pancreas. It is not so long since that we first appreciated the frequency in hyperthyroidism of an alimentary glucosuria or even of a frank glycosuria, whereas in hypothyroidism a normal or increased sugar tolerance was observed. An excellent paper by H. R. Geyelin,² in 1915, states that alimentary hyperglycemia and alimentary glycosuria are not uncommon in even the very mild cases of hyperthyroidism, and that in the moderate or severe cases a fasting or postprandial hyperglycemia was present in 90 per cent. of his series.

Our knowledge of the relationship of the internal secretion of the pancreas to glycosuria and hyperglycemia dates back to the work of von Mering and Minkowski (1890) and E. L. Opie (1903), and has since then received absolute confirmation.

The role of the hypophysis in carbohydrate metabolism was much more recently appreciated, although it had long been known that glycosuria was a frequent associated phenomenon of acromegaly. Thanks to von Noorden (1910) and Cushing (1912) the importance of the determination of the sugar tolerance for the diagnosis of a suspected disturbance of the hypophysis is now universally accepted. Further, as the result of the correlation of much experimental work and many clinical observations, it seems definitely established that the pars intermedia is directly concerned in carbohydrate metabolism and that hypertrophy of it causes polyuria, diminished carbohydrate tolerance or even a frank glycosuria, while hypoplasia or degeneration of the pars intermedia will result in a high degree of sugar tolerance.

In the early stages of acromegaly, therefore, it is common to find a decreased sugar tolerance as did we in two cases of acromegaly, one of secondary hyperpituitarism and in the two cases of dystrophia adiposogenitalis. (See Table I). On the other hand, in the latter stages of the hypophyseal disease, when the pars intermedia has been destroyed by pressure or by invasion, as occurred in our case of acromegaly from sarcoma of the pituitary gland, increased sugar tolerance is to be expected.

The method of sugar tolerance determination is too well known to require a detailed description. We accepted as the usual minimum normal limit 100 grams of glucose, which was administered to the

¹ Deutsch. Arch. f. klin. Med., 1914, cxvi, 461.

² Arch. Int. Med., 1915, xvi, 975.

TABLE I.

Case.	Diagnosis.	3 gtt. conjunctivally.		0.5 c.c. subcutaneously.		Carbohydrate tolerance.
		Adrenalin.	Pituitrin.	Adrenalin.	Pituitrin.	
	Cs��pai's normal	+10-20 min.	+ 0-10 min.	+30-60 m.m. sys.		
	Author's 15 controls . .	+10-30 min.	+ 0-25 min.	+ 3-42 m.m. sys.	+ 5-38 m.m. sys.	
1	Cs��pai's acromegaly . .	+15 min. -	+25 min. +	+60 m.m. sys. -	.....	Diminished.
2	Cs��pai's acromegaly . .	+10 min. -	+15 min. +	+70 m.m. sys. +	.....	Diminished.
3	Cs��pai's acromegaly . .	+35 min. +	+ 8 min. -	0 m.m. sys. -	.....	Normal or increased.
2	Cs��pai's dystro. adip. gen.	+35 min. +	0 min. -	0 m.m. sys. -	.....	Increased.
1	Author's acromegaly . .	+45 min. +	+15 min. +	+10 m.m. sys. -	0 " -	Increased to 300.
2	Author's acromegaly . .	+25 min. +	+15 min. +	+13 m.m. sys. -	+ 8 m.m. sys. -	Diminished.
3	Author's acromegaly . .	+15 min. -	+45 min. +	+ 2 m.m. sys. -	+12 m.m. sys. -	" with glycosuria.
	Author's hyperpituitarism	+35 min. +	0 min. -	+14 m.m. sys. -	+10 m.m. sys. -	Diminished.
1	Author's dystro. adip. gen.	+15 min. -	0 min. -	+28 m.m. sys. -	+13 m.m. sys. -	Diminished.
2	Author's dystro. adip. gen.	+ 5 min. -	+ 5 min. -	-14 m.m. sys. +	+10 m.m. sys. -	" with glycosuria.

fasting patient after an immediately preliminary examination of the urine and blood sugar; at hourly intervals blood and urine examinations were made for a period of four hours. Glycosuria and hyperglycemia, of course, indicate a decreased sugar tolerance; some even regard a slow return of the blood-sugar content to its previous normal as also pathognomonic. If neither glycosuria nor hyperglycemia occurs one administers on successive days, 200, 300 or even 400 grams of glucose. There is still some doubt as to the exact upper normal limit of the sugar tolerance, though it was formerly considered to be 250 grams. It might therefore be safer to say that in our first case of acromegaly the sugar tolerance was normal or increased.

It is well to bear in mind that in spite of the unusually protected site that the hypophysis enjoys, it is nevertheless susceptible to a disturbance of its function by greatly increased intracranial pressure from any cause, as internal hydrocephalus, tumor of the brain or of the adjacent tissues. Case V of our series was first considered to be a tumor of the silent area of the brain, but eventually the discovery of a flattened sella turcica and a decreased sugar tolerance seemed to justify a localization of the tumor in the region of the pituitary gland; accordingly a transsphenoidal decompression was undertaken. Though the postmortem three weeks later revealed a large sarcoma of the white matter of the occipitoparietal lobe, it was also found that the tremendous increase of intracranial pressure had not only thinned out the vertex of the skull to almost egg-shell transparency but had also completely flattened out the sella turcica and its contents, and so produced a general hyperemia of the hypophysis, with hemorrhage into the pars nervosa. We were therefore justified in a diagnosis of secondary hyperpituitarism.

The two methods suggested by Csépai were the conjunctival instillation of adrenalin or pituitrin and the subcutaneous injection of both.

THE CONJUNCTIVAL ADRENALIN TEST. In several hundred controls Csépai found that normally 3 drops of a 1 to 1000 solution of adrenalin will cause in a few minutes a slight or moderate blanching of the conjunctival sac, which will persist for ten to twenty minutes. The procedure is very simple and is, as a rule, easily and rapidly performed. The patient should be asked to keep both eyes closed for five minutes before the test. Further, only one conjunctiva is instilled, the other one being used for comparison.

My assistants used as normal controls fifteen medical patients, who showed no evidence of polyglandular disease. The controls were suffering from chronic bronchitis (2 cases), gastric neurosis (3 cases), lupus vulgaris, amebic dysentery, cardiorenal disease, secondary syphilis, tabes dorsalis, lethargic encephalitis, osteochondroma, peptic ulcer, cholecystitis and diabetes mellitus (1 case each). We found that the duration of the blanching was not so

constant as Csépai states, and varied from ten to thirty minutes. (See Table I.) In fact, this upper limit was observed in 4 of the 15 cases. Further, in one normal case, a girl with chronic bronchitis, there was no definite blanching on one occasion and on another test blanching occurred and lasted for twenty minutes. These discrepancies may be due either to errors in technic or to variations in the strength of the adrenalin solution. It is perhaps opportune here to state that all these tests were carried out by four well-trained interns (Dr. R. D. Taylor, Dr. A. W. Bennett, Dr. R. H. Gray and Dr. E. J. Voigt), who did not know what to expect, and only two of whom studied more than one polyglandular case and two normal controls, so that the personal equation was fairly well excluded. Further, only fresh adrenalin and pituitrin were used.

Exaggeration of the reaction indicates, according to Csépai, a diminished function of the adrenal glands. He noted a blanching of the conjunctiva of thirty-five minutes' duration in 1 case of acromegaly and in 1 case of adiposogenitalis, and of thirty minutes' duration in 1 case of Addison's disease and in 1 case of myxedema. In our series of 6 cases it was normal three times, slightly prolonged (twenty-five minutes) once, and decidedly prolonged (thirty-five to forty-five minutes) in 2 cases. (See Table I.)

Csépai also noted that in the cases in which the adrenalin reaction was positive (*i. e.*, the blanching prolonged) the carbohydrate tolerance was increased or normal. This relation did not hold for our series, for in only 1 of the positive cases was the carbohydrate tolerance increased, while in the other two there was distinctly decreased sugar tolerance.

THE SUBCUTANEOUS ADRENALIN TEST. It has long been known that the subcutaneous injection of 5 mg. of adrenalin is followed by a prompt increase in both diastolic and systolic blood-pressure as well as increase in the pulse-rate. Csépai found an increase of 30 to 60 mm. in the systolic pressure in normal cases. Such a pronounced increase we could not find in our twelve normal controls. Our increase ranged from a maximum of 42 to a minimum of 3 mm., or an average increase for the series of only 17 mm. in the systolic pressure. As a rule the diastolic pressures followed closely the systolic. (See Table I.)

Csépai found in 1 case of acromegaly, in another of dystrophia adiposogenitalis and in another case of myxedema, in all of which the conjunctival reaction was prolonged, no increase in the blood-pressure following the subcutaneous test. Our experience was quite different to this, however, as our 3 cases of prolonged conjunctival reaction showed a slight systolic increase of 10 to 14 mm., a figure, it is true, slightly below our normal controls, but not strikingly so. Further, 2 of the 3 cases with a normal conjunctival reaction showed either a very slight increase of 2 mm. or a very definite one of 28 mm. The third case, with normal conjunctival reaction, had

an actual fall of 14 mm. of systolic pressure, a phenomenon which we are at a loss to explain unless we can assign it to a faulty sample of adrenalin, as the two normal controls which received the same solution gave only a very slight increase in systolic pressure, namely 6 and 8 mm.

Further, Falta³ has pointed out that the subcutaneous administration of adrenalin causes a distinct leukocytosis, with an increase in the neutrophils at the expense of the mononuclear and eosinophilic cells. We have applied this test to twelve normal controls (see Table II) and noted a varying degree of leukocytosis in 8 patients, with an average increase of 1180 cells per c.mm., due to a slight increase in the neutrophils and a corresponding decrease in the mononuclears and eosinophiles. However, in four equally normal patients, as far as the endocrine glands was concerned, there was a decrease in the total white cells, averaging 1200 cells per c.mm. with little or no change in the leukocytic formula.

TABLE II.—ADRENALIN SUBCUTANEOUSLY.

Cases.	Diagnosis.	Blood picture before.						Blood picture two hours after.					
		Total white blood cells, per c.mm.	Polymorphonuclears, per cent.	Lymphocytes, per cent.	Transitions and large mononuclears, per cent.	Eosinophiles, per cent.	Mast cells, per cent.	Total white blood cells, per cent.	Polymorphonuclears, per cent.	Lymphocytes, per cent.	Transitions and large mononuclears, per cent.	Eosinophiles, per cent.	Mast cells, per cent.
	Av. 8 positive controls . .	+1,880	76	27.0	1.5	0.75	0	..	78	22.0	1.0	0.3	0
	Av. 4 negative controls . .	-1,200	70	25.0	1.7	0.25	0	..	71	27.0	2.5	0.2	0
1	Csépai's acromegaly . .	5,100	38	48.0	4.0	8.0	2	4,800	69	24.0	4.0	3.0	0
2	Csépai's acromegaly . .	6,000	62	33.0	3.0	2.0	0	7,000	67	27.0	1.0	5.0	0
3	Csépai's acromegaly . .	4,700	54	35.0	5.0	5.0	2	..	..	..	..	..	..
1	" dystro. adip. gen.	5,100	54	39.0	5.0	2.0	0	..	..	..	..	..	..
2	" dystro. adip. gen.	4,200	31	48.5	12.0	5.5	3	6,800	63	26.6	8.8	1.2	0.4
1	Author's acromegaly . .	6,000	52	35.0	9.5	3.5	..	9,600	61	33.0	6.0	0.0	0
2	Author's acromegaly . .	5,080	62	32.0	4.0	1.0	..	4,200	67	30.0	3.0	0.0	0
3	Author's acromegaly . .	7,900	77	18.0	4.0	..	..	6,200	76	19.0	4.0	1.0	0
	" hyperpituitarism	8,600	69	28.0	2.0	1.0	..	9,800	76	22.0	2.0	0.0	0
1	" dystro. adip. gen.	4,900	70	26.0	1.0	3.0	..	5,600	74	25.0	1.0	0.0	0
2	" dystro. adip. gen.	15,400	78	18.0	2.0	1.0	..	18,200	82	16.0	1.0	..	1

This test was first applied by Csépai to his hypophyseal cases, in which he found either no increase, or, at the most, a slight increase in the total leukocytes, with, however, a slight relative increase of the neutrophils at the expense of the mononuclears and to a less extent of the eosinophiles. Csépai, therefore, stated that any variation from the normal leukocytosis indicates disease of the ductless glands.

In our series there was only 1 case, and that after operation,

³ Die Erkrankungen der Blatdruesen, Berlin, 1913, p. 280.

which showed a distinct leukocytosis of 3600 cells with a slight increase of the neutrophiles and a corresponding decrease in mononuclears and eosinophiles. In the other 5 cases there was either no leukocytosis, or, at the most, a very slight one, with an average increase of 584 cells per c.mm. as compared with an increase in our 12 normal cases of 1180 cells, a difference, we believe, too small to be duly emphasized. Further, there was no constant relationship between the effect of the adrenalin upon the blood-pressure and the effect upon the leukocytic formula.

THE CONJUNCTIVAL PITUITRIN TEST. Csépai found that normally drops of the commercial pituitrin as ordinarily used in obstetrical practice when instilled into the conjunctival sac cause no blanching or at the most only a very slight pallor lasting ten minutes. These figures were the result of many observations by Csépai, though he does not state the exact number of patients tested.

We used 12 patients as normal controls (see Table I) and found no blanching, but rather reddening of the conjunctiva in 4 cases, a slight blanching of ten minutes' duration in 3 other cases, while in 5 others the blanching lasted from fifteen to twenty-five minutes. In other words, 7 gave a reaction within Csépai's normal limits, while in 5 it was prolonged and therefore pathological, according to Csépai. He found in 2 cases of acromegaly a prolonged reaction (fifteen to twenty-five minutes), but a normal one in 1 case of acromegaly, 1 of dystrophia adiposogenitalis, 1 of Addison's disease, 1 of myxedema, 1 of Graves's disease and 1 of diabetes mellitus.

In our 3 cases of acromegaly the blanching lasted fifteen minutes in 2 cases and forty-five minutes in 1 case. The reaction was absent or at the most very slight in the secondary hyperpituitarism, and in both patients with dystrophia adiposogenitalis. We further cannot confirm Csépai's observation that when the adrenalin reaction was strongly positive the pituitrin was negative and conversely. We feel rather than the pituitrin conjunctival reaction is not as constant or as reliable as the adrenalin and that many more controls in the normal and diseased states will be necessary before any reliance can be placed upon this test.

THE SUBCUTANEOUS PITUITRIN TEST. Following Csépai's suggestion the effect upon blood-pressure of the injection of 0.5 c.c. of pituitrin was observed. In 1914 he was not ready to publish his own data. Therefore, the 12 normal controls of our own series are the only ones available for comparison with our abnormal cases. (See Table I.) The blood-pressure, both systolic and diastolic, was read at ten-minute intervals for one hour. In Table I only the maximum systolic increase is recorded. This increase varied from 5 to 38 mm., or an average for 11 cases of 15 mm. One normal case showed a fall of 18 mm. without any apparent reason, as both the pathological case and the other normal control showed well-defined increases of the systolic pressure. In other words, the increase of

systolic pressure following 0.5 c.c. of pituitrin is very little less than that following 5 mgm. of adrenalin. Our 3 cases of acromegaly showed an average increase of 7 mm., while the other 3 pituitary cases showed an average increase of 11 mm. in the systolic blood-pressure. There may be therefore a slighter response to subcutaneous pituitrin in patients with acromegaly than in the normal person or even than in dystrophia adiposogenitalis and secondary hyperpituitarism.

TABLE III.—PITUITRIN SUBCUTANEOUSLY.

Cases.	Diagnosis.	Blood picture before.						Blood picture two hours after.					
		Total white blood cells, per c.mm.	Polymorphonuclears, per cent.	Lymphocytes, per cent.	Transitions and large mononuclears, per cent.	Eosinophiles, per cent.	Mast cells, per cent.	Total white blood cells, per cent.	Polymorphonuclears, per cent.	Lymphocytes, per cent.	Transitions and large mononuclears, per cent.	Eosinophiles, per cent.	Mast cells, per cent.
1	Av. 7 positive cases . .	+1,128	75	22	1	0.4	0.2	..	76	23	1	0	0
	Av. negative cases . .	-1,380	71	26	2	1.0	0.2	..	71	26	2	1	0
	Author's acromegaly . .	7,800	60	35	3	2.0	..	6,400	60	28	9	3	0
2	Author's acromegaly . .	5,800	69	26	5	0.0	..	5,700	73	23	2	1	1
	Author's acromegaly . .	6,200	71	27	2	0.0	..	6,400	68	29	3		
1	" hyperpituitarism . .	8,600	67	32	1	0.0	..	8,400	70	29	1		
2	" dystro. adip. gen. . .	5,900	64	34	2	0.0	..	4,900	68	32			
	" dystro. adip. gen. . .	9,600	78	19	1	2.0	..	14,400	73	26	1		

The effect upon the leukocytes two hours after the injection was noted by us in 12 normal cases. (See Table III.) In 7 of the cases there was an average increase of 1128 cells, with a slight increase in the neutrophils but no change in the mononuclears or eosinophiles. In 5 cases, however, there was a distinct decrease in the total white cells averaging 1380 cells, but again practically no change in the blood formula. In all 3 cases of acromegaly, as well as in the case of secondary hyperpituitarism and 1 case of dystrophia, there was a slight but definite decrease which averaged 500 cells per c.mm. There was practically no change in the blood formula. In the case of dystrophia, with an associated pelvic cellulitis, there was a distinct leukocytosis.

CONCLUSIONS. 1. That a secondary hyperpituitarism may result from a greatly or rapidly increasing intracranial pressure, as in Case IV of our series.

2. That the determination of a decrease in the sugar tolerance in the presence of other symptoms of disturbance of pituitary function justifies a diagnosis of increased activity of the pars intermedia.

3. That the adrenalin conjunctival test may be of positive value in certain cases of dyspituitarism in demonstrating a hypofunction of the chromaffin system.

4. That the subcutaneous adrenalin test was only of doubtful value in both the normal and diseased cases studied by us.

5. That both the conjunctival and subcutaneous pituitrin tests were too equivocal to be depended upon for studying the functional activity of the hypophysis.

6. That the internal administration of the pituitary extract of either the whole gland or the anterior or the posterior lobes appears to exert no definite influence upon the symptomatology of the disease.

THE PROBLEM OF NUTRITION AND A SATISFACTORY METHOD OF FEEDING IN HIGH INTESTINAL FISTULAS.

BY MAX MINOR PEET, M.A., M.D., F.A.C.S.,

ASSISTANT PROFESSOR OF SURGERY, UNIVERSITY OF MICHIGAN.

THE problems presented by high intestinal fistulas may be roughly divided into two groups: The first, which concerns both the surgeon and the internist, is the question of nutrition, and the second, of special interest only to the surgeon, is the successful closure of the fistula. The object of this paper is to offer a satisfactory solution of the first problem, namely, a method to supply adequate nourishment to patients suffering from this condition.

High intestinal fistulas, by which we mean external fistulas involving the duodenum, jejunum and upper ileum, are frequently seen in any large hospital service and appear occasionally in the practice of most surgeons and internists. Of the etiological factors, one of the most common is appendicitis, with abscess or infected mesenteric thrombosis. Tuberculous peritonitis involving the intestine is notoriously prone to develop fistulas, particularly after operative intervention. Traumatic injuries, with primary perforation or with intestinal devitalization and secondary perforation occurring both from extra-abdominal causes and in the course of a laparotomy, have led many times to the same condition. Enterotomies are frequently performed when the patient is *in extremis* from strangulated hernia, paralytic ileus or other intra-abdominal obstruction, and often the physical condition must be greatly improved before a secondary operation to close the defect can be made. Finally, we have the malignant growths, which, following exploration, involve the adjacent abdominal wall and ulcerate through. The final outcome is, of course, hopeless, still much can be done in the way of suitable nourishment to make life more comfortable.

The necessity of some method for the successful introduction of foods is evident to anyone who has had charge of these cases. The fluid loss alone is a serious one. While some fluid is probably ab-

sorbed throughout the whole of the small intestine, a considerable portion is absorbed in the large gut, and since the material escaping from high intestinal fistulas is always fluid, serious dehydration cannot help but take place. This loss of water not only depletes the body of an essential constituent, but places an additional burden on the kidneys, lowers the resistance to infection and is frequently the cause of much distress from thirst.

The constant escape of fluids bearing pancreatic and intestinal secretions, together with foods in process of digestion, causes a marked excoriation of the skin surrounding the fistula. The application of vaselin, zinc oxide, talc, rubber in solution, etc., which is recommended by nearly all writers, does not prevent this moist eczema, and warm baths only allay the condition temporarily. It is only in exceptional cases that the introduction of a rubber tube to drain away the secretions or the insertion of a vaselined gauze plug is successful. A method which permits the withholding of fluids and food by mouth, while not entirely preventing the escape of irritating secretions, lessens the discharge enormously and helps materially in clearing up the skin condition.

The loss of food products is second only to that of fluids, if in fact it is not more important, since fluid alone can be introduced for some time by other routes, and in the upper intestine the absorption of water is greater in proportion than the absorption of products of digestion. In jejunal and high ileal fistulas the food is still in process of cleavage, so that even if absorption above the fistula were adequate, much of the material is in too complex a form to be assimilated. The loss includes all three essential foods—carbohydrates, fats, and proteins—besides the inorganic salts and possibly some of the little understood substances commonly known as vitamins. The gravity of this loss is evidenced by the rapid emaciation and loss of strength so frequently seen in patients with no other drain on their physical well-being than a fecal fistula. If we add to this the deleterious action of some of the etiological agents mentioned above, we will realize the hazardous position in which the patient is placed and the necessity to overcome the obstacles to proper nutrition as rapidly as possible. Not only is the patient less able to cope with severe infections, but he may be in most unfavorable condition to withstand operative closure of the defect. We have here a vicious circle, the loss of intestinal contents progressively weakening the patient and demanding more and more the closure of the fistula, while the decreasing vitality makes the operation constantly more dangerous. The answer would be simple if these cases were always seen at a time when the ill-effects of undernourishment were not marked; but, unfortunately, this is not the rule. On the other hand, some cases, due to the preëxisting disease, are in too precarious a condition at the time the fecal fistula develops to undergo surgical treatment.

Attempts have been made to control the amount of discharge from a fecal fistula by frequent feeding of small amounts by mouth. While this is undoubtedly of some benefit, the results, especially in the jejunal fistulas, are discouraging.

Attempts to artificially restore the continuity of the intestinal canal by passing a rubber tube from the upper segment to the lower have been successful in only a small proportion of cases. This result is to be expected, since in only a small percentage will the fistulous tract be sufficiently open to make the insertion of a tube into each end of the gut possible. The opening resulting from emergency operations, such as enterostomies (artificial anus), is practically the only type in which the above method can be used, as a tube large enough to fill the intestinal lumen is needed, otherwise there is a pronounced leakage.

Rectal alimentation is serviceable for only short periods and has many limitations. Some cases of low fecal fistula which had persisted for long periods have closed spontaneously in a comparatively few days when food by mouth was discontinued and rectal feedings given. None of those reported appear to have been in serious condition from inanition and the actual value of the rectal administration is problematical, although the beneficial action on the fistula of the empty small intestine is unquestioned.

Recent work has cast considerable doubt on the efficacy of the ordinary nutrient enema. Fats are probably not absorbed in any form from the large intestine. Protein, either in the form of whole milk or as peptonized milk, is recommended by most writers, and will be found in general use in nearly every hospital. Even raw eggs are included in the formulas by many. The evidence, however, is strongly against the value of plain milk or eggs, since no proteolytic enzymes other than bacterial exist in the large intestine, and the latter certainly cannot be depended upon.

The value of thoroughly peptonized milk cannot yet be definitely stated, since the experimental work on the subject is still incomplete. Clinical evidence seems to point strongly in its favor, but more careful investigations recently conducted indicate that only amino-acids are absorbed in the colon and that the proteins in peptonized milk are not sufficiently split to allow of their utilization by the body. Amino-acids are not obtainable on the market in sufficient quantity for rectal alimentation, and if they were the price, at least at present, would be absolutely prohibitive.

The evidence is also incomplete in reference to the absorption of milk and cane sugars. Glucose, however, is evidently readily utilized. Five to 10 per cent. is recommended, and its incorporation in all nutrient enemas urged. We can only say that, so far as our present knowledge goes, nutrient enemas should contain glucose, leaving the question of adding peptonized milk to the individual physician. The former can be depended upon to furnish many

calories and to conserve the body fats and proteins, while the latter may be proved by further experimentation to be unsuitable for rectal alimentation.

The question of the absorption of sufficient calories is not the only one which confronts us in dealing with this problem. The irritability of the rectum is well known and constitutes a serious handicap in colonic feeding. This irritability varies with different individuals, but seldom is a patient found who can tolerate the continued introduction of either saline or tap water by rectum for more than three or four days. A very small soft-rubber catheter causes less irritation than the usual rectal tube and the tendency for prompt expulsion of the enema is less. In the same way the introduction of small quantities of fluid, at the proper temperature and under very low pressure, increase the chances of its retention. These, in fact, are the essentials of the Murphy drip and explain why it is so successful for limited periods. Large amounts of fluid are almost certain to be rejected by the colon after two or three injections, while the continued use of small amounts, even when administered in the most favorable way, soon produce irritation and the hypersensitive colon refuses longer to act as a stomach. These facts applied to rectal alimentation show us the fallacy of expecting more than temporary benefit from this method, for the rectum and colon will not tolerate the quantity of fluid sufficient to carry the required number of calories nor the introduction of small amounts at the short intervals necessary to obtain the same result.

The method of feeding in high intestinal fistulas, which the author has found most successful, has probably been used by many operators; but it does not seem to be generally known, and in a recent review of the literature only one reference to it was found. This was by Fowler¹ in Johnson's *Operative Therapeutics*. In speaking of feeding in cases of artificial anus he says: "An attempt may also be made to place predigested foods in the efferent loop of the fistula. If this is possible it not only nourishes the patient better but prevents contraction of the portion of the bowel below the fistula. Reverse peristalsis tends to prevent feeding through the efferent loop." Under a discussion of fecal fistula he states: "When the opening is situated high up in the intestinal canal and the condition of the patient is such that an operative procedure is contraindicated, a temporary expedient of inserting a rubber tube, on the same principle as that employed by Kerr in draining the bile ducts, may be employed. In a personal case this simple device effected an absolutely mechanical closure and tided the patient over until sufficiently recuperated to withstand a formal operation. Nutrition was maintained through a small catheter inserted through a minute opening in the wall of the larger tube into the efferent intestine."

¹ New York, 1916, iv, 348-350.

In the author's experience he has had no difficulty with reversed peristalsis. This is possibly due to the use of a very small soft tube and its insertion for several inches down the efferent loop.

The method found most successful for intestinal fistula is essentially the same as is used for rectal feeding, but has not the limitations which hamper the latter. A very small soft rubber catheter, preferably lubricated with olive or sweet oil, is carefully inserted through the fistulous tract into the distal loop of intestine. No attempt should be made to force the tube in, but by gently turning the catheter about it will usually pass with little or no difficulty. At first it may pass into the upper loop, and in some cases it is impossible to determine at once which loop it has entered. If in the upper loop, intestinal contents soon appear through the catheter or the material injected is promptly expelled. As a general rule, however, no difficulty will be found in passing the tube into the lower segment. It should enter for three or four inches at least, and with five or six inches the tendency for the fluid introduced to flow back around the catheter is practically negligible.

The food for introduction must, of course, be fluid, and any particles liable to obstruct the small opening in the catheter should be carefully removed. It should be warmed slightly above body temperature, otherwise marked peristalsis may set up and the gut temporarily occluded. We have found the administration of three or four ounces every hour during the day and at two- or three-hour periods during the night to be very satisfactory. Larger quantities are more liable to cause irritation and possibly reversed peristalsis. The fluid can also be given readily by the Murphy drip. Whatever method is used, the administration should be slow and the fluid allowed to flow in by gravity. A height of six inches is usually sufficient to overcome the intra-abdominal pressure. The tube may be inserted at each feeding or left *in situ*. If insertion is easily performed we advise the introduction only at feeding times. When difficult, requiring the experience of the surgeon to insert it, the tube may be left in place, and being very small and soft, will probably cause little irritation.

Unlike rectal alimentation the enteric feeding in intestinal fistula is not confined to very simple products. Whole milk can be given freely, but should be peptonized. Raw eggs are tolerated, but it seems best to partially digest them as well. Beef juices are recommended, especially from thoroughly crushed meat forced through a strainer. This furnishes a large amount of protein from the muscle cells pressed out, and being free from connective tissue, passes readily through the catheter.

Glucose in 5 per cent. solution should always be added to the formula. Whisky may be added when indicated. The salts and vitamins will be furnished by the milk and beef juices. When much bile escapes from the upper loop, some of this should be col-

lected and introduced with the feedings. Oatmeal broths and other farinaceous-bearing fluids can be safely given if desired. In threatened acidosis, alkalies may be introduced as readily as per rectum. This type of feeding can be continued indefinitely and the patient brought back to good physical condition before a secondary operation need be performed. It also prevents contraction of the gut below the fistula, a great help in the after-treatment of these cases.

CONCLUSIONS. The problem of nutrition in high intestinal fistulas is a serious one. The loss of fluids and products of digestion steadily lowers the patient's resistance to infection, and so weakens his physical condition that operative interference is extremely hazardous. The administration of small amounts of food by mouth does not materially improve the condition. Mechanical measures to conduct the fluids from the upper to the lower intestinal loop or to occlude the fistulous tract are successful in only a very small number of cases. Rectal alimentation has many limitations, chief of which are the failure of absorption of sufficient calories and the short time the colon will tolerate nutrient enemas. Enteric administration of foodstuffs through a small, soft catheter, inserted by way of the fistula into the efferent loop, is successful. By this method sufficient calories are utilized to maintain a good physical condition and to build up an emaciated patient, so that he can withstand necessary operative treatment.

LATER STAGES OF SO-CALLED WAR NEPHRITIS.

BY TASKER HOWARD, M.D.,

CLINICAL PROFESSOR OF MEDICINE, LONG ISLAND COLLEGE HOSPITAL, BROOKLYN, N. Y.,
FORMERLY MAJOR, M.C., CHIEF OF MEDICAL SERVICE,

AND

A. F. ROBERTSON, FIRST LIEUT., M.C.,

STAUNTON, VA.,
BASE HOSPITAL, CAMP LEE, VA.

THE unusual number of cases of acute nephritis occurring in the various armies overseas has been the subject of much comment and study. It has been maintained by some authors, notably Ameuille,¹ that war nephritis constitutes a hitherto unrecognized clinical entity, differing in some respects from nephritis as ordinarily seen in civil life. This opinion is not shared by others. Christian,² after reviewing the literature of the subject, concludes that "war

¹ Translation by Mosenthal: Jour Urol., 1918, ii, 51.

² Prog. Med., 1919 xxi, 135.

nephritis" is not a new disease entity but represents a wide variety of the clinical manifestations of acute nephritis.

During the past few months the Base Hospital at Camp Lee, Va., has received a number of such patients in whom the duration of the disease averaged a little under four months. The clinical findings of these patients at this stage of convalescence offer some data bearing upon the course and prognosis of the disease. Our cases were studied too late to present much evidence bearing on the question of the nature of the original attack.

Thirty-seven patients were received at this hospital from overseas with a diagnosis of nephritis. Our investigation of these patients brought out the following facts:

Period Since Onset. The period that had elapsed since the onset of the disease until admission varied between two and seven months, averaging 3.8, but in 75 per cent. of the cases ranged from three to five months. The length of stay in the hospital averaged a little over three weeks, so that most of the observations were made about the fourth month.

Past History of Nephritis. 3 of the 37 patients had had previous attacks of nephritis. Of these 2 recovered from the present attack and 1 was found to have well-developed chronic nephritis.

Edema. 35 of the 37 had edema at the onset. Of the 2 who did not, 1 had a chronic nephritis, dying at this hospital of uremia, and 1 had apparently recovered. At this hospital edema was found in but 2, both having chronic nephritis.

Focal Infection. Teeth and tonsils were examined in 26 cases. Foci of infection were found in 13 of these (50 per cent.), tonsillar disease being present in 10 and root infection in 4.

Albuminuria. Albuminuria was found to be present in 31 cases (83 per cent.), and persisted in 24 (64 per cent.). In the absence of other indications of nephritis these patients were considered to have recovered.

Cylindruria. Cylindruria persisted in 16 cases (43 per cent.). This factor was also practically disregarded.

Sodium Chloride Excretion. Sodium chloride excretion was found to be normal in nearly all the cases in which it was estimated. In 26 patients the average excretion was 9.5 gm., only 7 excreting below 7 gm., all of these being over 5 gm. except one, who excreted but 0.5 gm. during an acute exacerbation of the disease, the salt intake at this time, of course, being much restricted.

Nitrogen Excretion. Nitrogen excretion was estimated while patients were on a full ward diet in 24 cases. The average output was 10 gm. In 7 cases the output was below 8 gm., the lowest figure being 6 gm.

Twenty-four-hour-urine Output. The urine was measured in 34 cases. It exceeded 1500 c.c. in 7 cases. In 5 of these 7 cases there was ample evidence of impaired kidney function; 1 showed

nycturia and hyposthenuria as the only other evidence of kidney involvement, while 1 was normal in every other respect. Oliguria was pronounced in 3 cases during acute exacerbations of apparently chronic nephritis; 11 excreted less than 1000 c.c. The average twenty-four-hour-output was 1229 c.c.

Amount of Day and Night Urine. The amount of urine excreted between 8 A.M. and 8 P.M. was compared with the amount excreted between 8 P.M. and 8 A.M. in 33 cases. The night urine exceeded 50 per cent. of the day urine in 27 cases (81.8 per cent.). It exceeded 75 per cent. of the day urine in 19 cases (57.5 per cent.). In 4 it equalled or exceeded the day urine.

Specific Gravity of Day Urine. Maximum was over 1.018 in 28 cases, between 1.015 and 1.018 in 1 case and under 1.015 in 7 cases.

Specific Gravity of Night Urine. This was above 1.018 in 18 cases, between 1.015 and 1.018 in 3 and below 1.015 in 13 cases. Of the 13 cases with a night urine below 1.015, 12 had other manifestations of kidney involvement and 1 did not. Of the 3 between 1.015 and 1.018, 2 had recovered and 1 still showed other evidences of pathology; 76 per cent. of the active cases and 17 per cent. of the recovered passed night urine of a specific gravity of less than 1.018.

Two-hour Variation in Concentration. This variation was studied in 35 cases. Variations of less than 6 points were noted in 13 patients. Of these 7 still had nephritis and exhibited decidedly lower maximum concentrations than the 6 who had recovered. In this series fixation of specific gravity without hyposthenuria appeared to be of little significance.

Blood Urea. Blood urea was estimated in 35 cases; of these 11 showed a concentration of 35 mg. or more per 100 c.c., while 24 showed lower figures. Two of the 11 with blood urea above 35 mg. (38 mg. and 40 mg.) had apparently recovered while the other 9 still had nephritis. Of course a number of patients with blood urea below 35 mg. were definite nephritis cases. The findings are tabulated in Table I.

TABLE I.—BLOOD UREA (MG. PER 100 C.C. BLOOD).

330 mg.	1 (died)
230 " (later reduced to 110)	1
190 "	1
134 "	1
80 to 90 "	1
50 to 60 "	1
40 to 45 "	1
35 to 40 "	4
30 to 35 "	3
25 to 30 "	2
20 to 25 "	9
25 to 20 "	6
Below 15 "	4

The Phenolsulphonephthalein Test. This test was done in 36 cases. Table II shows the results. A moderate depression was not uncommon in soldiers who showed no other signs of nephritis. Thus of the 8 with a reading between 40 and 50 per cent., 5 had apparently recovered. Of 11 below 40, 2 had recovered and 9 had not.

TABLE II.—PHENOLSULPHONEPHTHALEIN OUTPUT IN TWO HOURS AND TEN MINUTES.

70 to 80 per cent.	. . . . .	1
60 to 70	"	4
50 to 60	"	12
40 to 50	"	8
30 to 40	"	3
20 to 30	"	1
10 to 20	"	1
0 to 10	"	6

Systolic Blood-pressure. Systolic blood-pressure was estimated in 37 cases. Of the 12 cases with a reading of 140 or over, 10 (83 per cent.) still had nephritis, the other 2, in whom the maximum reading just touched 140, showed no other signs of nephritis. On the other hand 6 (24 per cent.) of the 25 whose blood-pressure never reached 140 were nevertheless considered active cases. They were much milder in type, however, than the patients with higher readings, and were practically all convalescing and seemed quite likely to recover entirely.

TABLE III.—SYSTOLIC BLOOD-PRESSURE.

Over 200	2
190 to 200	0
180 to 190	2
170 to 180	1
160 to 170	2
150 to 160	1
140 to 150	4
130 to 140	9
120 to 130	8
110 to 120	6
100 to 110	2

Diastolic Pressure. Diastolic pressure exceeded 100 in 8 cases; 6 of these were well-marked cases of nephritis, 1 had slight corroborative evidence of activity and 1 had apparently recovered; 11 active cases had a diastolic pressure below 100.

Eye-grounds. Four showed pathology in the eye-grounds. Hemorrhages were found in 2, albuminuric retinitis in 2, retinal edema in 1 and papilledema in 1. They were all well-marked cases.

Anemia. A moderate degree of anemia was common. The erythrocytes were counted in 22, of whom 17 had less than four million.

Four to five million was the commonest count. The average was 4,147,500.

TABLE IV.—ERYTHROCYTES.

1,000,000 to 2,000,000	. . . . .	31
2,000,000 to 3,000,000	. . . . .	2
3,000,000 to 4,000,000	. . . . .	5
4,000,000 to 5,000,000	. . . . .	9
5,000,000 to 6,000,000	. . . . .	5

Outcome. A diagnosis in these patients was determined by the complete picture in each case, no one factor exclusively being considered pathognomonic. Of the 37 cases, 19 were discharged as having completely recovered and 18 showed definite evidence of kidney pathology. The time that had elapsed since the onset of the disease was practically identical in these two groups, averaging 3.85 months for the former and 3.75 months for the latter. Of the 18 active cases, 1 died of uremia, 8 presented the picture of well-established, chronic, interstitial nephritis and 9 showed less distinctive features and seemed to have a fair chance of ultimate recovery.

SUMMARY. 1. Thirty-seven cases of nephritis contracted overseas were studied at a period averaging four months.

2. One-half have recovered, one-quarter have developed chronic nephritis (with one death), one-quarter still have nephritis but may ultimately recover.

3. Persisting albuminuria is common but is considered of little prognostic significance.

4. Polyuria is not uncommon, and when it occurs is a valuable sign.

5. Relative increase of night urine is practically constant in active cases and is not infrequently the only anomaly in the apparently recovered.

6. Blood urea above 35 mg. per 100 c.c. usually meant nephritis, as proved by other factors. Normal readings were frequently found in active cases.

7. Moderate reductions of phenolphthalein output is not an uncommon finding in those patients who have apparently recovered.

8. An elevated blood-pressure proved the most reliable single sign.

9. A moderate degree of anemia is extremely common.

LETHARGIC ENCEPHALITIS IN THE A. E. F.: A CLINICAL STUDY.

BY A. SKVERSKY, M.D., CAPT., M.C., U.S.A.,

NEW YORK.

LETHARGIC encephalitis, so-called, has been a subject of considerable study and speculation on the European continent since the spring of 1917, and though the disease appeared in a more or less epidemic form, its association with any other current epidemic was not established. Case reports were justifiable, as they conformed, in the main, with the simple descriptive term—lethargic encephalitis; but the clinical pictures were varied, particularly in mode of onset and course; they did not spare any part of the central nervous system and the range of mortality varied from 20 to 50 per cent. (British report,¹ Netter,² Findlay,³ von Economo⁴). The results of pathological investigation have been fairly uniform, in that the central nervous system presented an inflammatory process resembling that of syphilis, poliomyelitis and relapsing fever, with a tendency to selection of the basal ganglia, midbrain and the bulb. Up to date no pathogenic agent has been established, though the bacteriological investigations of Bradford, Bashford and Wilson,⁵ in which a filtrable virus, isolated from brain tissue, and resembling that found in acute infectious polyneuritis, may point the way.⁶ Lethargic encephalitis has become a reportable disease in British public health work.

In the United States interest was directed to this mysterious disease during and soon after the height of the last epidemic of influenza, and the literature of case reports is now becoming extensive. A number of deaths have already occurred in New York City and elsewhere, but the results of pathological and bacteriological investigations are still forthcoming and are being awaited with considerable interest for comparison with the findings of European observers.

¹ Report on an Inquiry into an Obscure Disease, Encephalitis Lethargica, Local Government Board Reports on Public Health and Medical Subjects, London, N. S., 121.

² Lethargic Encephalitis, Bull. Acad. de méd., May 7, 1918, lxxix, 337; Paris méd., August 3, 1918, viii, 81.

³ Lethargic Encephalitis, Glasgow Med. Jour., October, 1918, xc, 193.

⁴ Verein f. Psych. u. Neur. in Wien, April 17, 1917; Wien. klin. Wchnschr., May 10, 1917; Neurol. Centralbl., November 1, 1917.

⁵ British Med. Jour., London, February 1, 1919, No. 3031, vol. i.

⁶ Attention has been recently directed to the work of Drs. I. Strauss and L. Loewe, at Mt. Sinai Hospital, New York City (Etiology of Epidemic Encephalitis, Jour. Am. Med. Assn., October 4, 1919), wherein it is claimed that a filtrable virus was isolated from the nasopharynx of patients suffering from epidemic encephalitis. This organism resembles in morphology, appearance of colonies and growth that described by Flexner and Noguchi in poliomyelitis, and has up to date been carried to the twelfth generation.

With the American overseas forces this new disease picture has been so infrequently met with and of such comparatively recent observation that it has aroused a sporadic interest only. If, as seems to be the general consensus of medical opinion, this disease has followed in the wake of the influenza epidemic, it is interesting to note that the American overseas forces, which have not been altogether spared by the scourge of influenza, should have seen so little of lethargic encephalitis. We have become familiar with the usual transient nervous manifestation associated with influenza; the concomitant delirium, the residual neurasthenic and psychasthenic states and often the latent psychoses precipitated by acute infection. There is, however, a tendency, as noted in some of the cases reported as lethargic encephalitis, to include some of these disorders, which must add to the perplexity already existing in the attempt to establish a distinct clinical entity. In a recent communication by Menninger⁷ on the psychoses associated with influenza in Boston, a review of nearly 100 cases, wherein the central nervous system was involved, no symptoms referable to our present conception of the lethargic encephalitis were considered. This leads one to question the relationship which may exist between lethargic encephalitis and influenza. On the other hand the observations of Bassoe⁸ in Chicago, Mayer⁹ in Pittsburgh, and Neal¹⁰ in New York, offer a more pertinent basis for epidemiological consideration.

During the months of January, February and March of this year, G. H. Q. Base Hospital No. 90 had about 10 cases, which were considered as belonging to this group, because of definite involvement of the central nervous system associated, in most instances, with unmistakable lethargy. The majority of these cases were later seen and considered by other observers as those of lethargic encephalitis, but aside from the main features which seem to legitimize this diagnosis, the variability of the general clinical pictures and their resemblance to other well-recognized diseases of the nervous system were so striking as to call forth considerable discussion and divergence of opinion. The results of these clinical studies form the basis of this communication.

CASE I.—Pvt. (1st class), M. G.; M.D., B. H. 90. Admitted to B. H. 90 January 28, 1919.

History. Always of delicate physical constitution and inclined to be nervous. Present illness: "Bad cold" during first week in January and following a short leave to southern France, he thought

⁷ Psychoses Associated with Influenza, Jour. Am. Med. Assn., January 25, 1919.

⁸ Jour. Am. Med. Assn., March 1, 1919, lxxii, 677.

⁹ Post-Influenzal Disturbances of the Nervous System, Jour. Am. Med. Assn., March 1, 1919, p. 670.

¹⁰ Meningeal Conditions Noted during the Epidemic of Influenza, Jour. Am. Med. Assn., March 8, 1919, lxxii, 714.

he had recovered. After returning to duty he coughed excessively, but was not incapacitated. Two days before admission to the hospital, while sitting in the squad-room, he felt a sudden and sharp pain in the back of his head; objects appeared blurred and he saw double. He felt weak and unable to return to his quarters without assistance. On the following day, headaches, horizontal diplopia to the left, swallowing difficulty, requiring liquid food (no sore-throat), buzzing in both ears and twitching of the right facial and shoulder muscles. He felt a heaviness of his face and eyelids; was very drowsy and weak.

Examination on Admission. Very somnolent, but when stimulated his sensorium was not clouded. Temperature ranged from 100° to 102° (afternoon). Poor muscular development; chest elongated; skin dry and harsh. Marked drooping of both upper lids, with corrugation of the forehead, right internal strabismus and diplopia, pupils markedly dilated, but react promptly; all extra-ocular excursions were slow and restricted; eye-grounds normal. Swallowing retarded and difficult; no rigidity of neck or Kernig. Deep reflexes increased; pseudo-Babinski on the left; no clonus; abdominals present; no nerve or muscle tenderness; sensation and deep sensibility unimpaired. Marked weakness and ready fatigue. Lungs: dulness and fine crackling rales in right apex; no thymic dulness. Sputum and roentgen ray of chest negative; throat culture; blood count and urine negative. Spinal fluid, five cells, trace of globulin; Wassermann, blood and spinal fluid negative.

Clinical Course. Was kept absolutely at rest; continued to run an afternoon temperature for about a week, with an occasional chill, temperature reaching 103°. The ocular weakness and ptosis gradually cleared up. Marked constipation, requiring massive doses of cathartics with enemata. After a few weeks the most pronounced feature was his ready fatigability on the slightest exertion, though while at rest he did not complain. Two months after admission he presented a general constitutional improvement, though his physical reduction was evident. Gait was weak, and walking a few yards was followed by general exhaustion, requiring long rest for recuperation. There was still a right internal rectus paresis, which failed completely upon convergence. Faradic stimulation of the extensors of hands and fingers was followed by a ready exhaustion (myasthenic reaction of Jolly). Seen by Lieut.-Col. Zabriskie on March 26, who considered the case one of lethargic encephalitis, with a myasthenic picture.

In this case there was an abrupt onset, an early febrile period of about a week, with bulbar symptoms, which during further course and with absolute rest showed a fairly rapid improvement. There remained, however, a sustained and ready fatigability on the least exertion, with a myasthenic electrical reaction. Aside from the abrupt onset this case presents a picture difficult to

distinguish from myasthenia gravis, and, as was learned later, after transfer of the patient to Savenay for discharge to the States, there was considerable divergence of neurological opinion as to the ultimate classification of this case.

CASE II.—Cook, M. A., P. W. E. 233. Admitted to B. H. 90 from C. H. 38, January 30, 1919, with diagnosis of "psychosis, exhaustive possible specific."

The card of admission to the C. H. on January 27 stated influenza and eye trouble, but no further information.

History (from patient). Following a motor-cycle accident, about two weeks before admission, when he was struck on the left knee, being shaken up but not seriously hurt, he began to suffer a gradual and progressive failure of vision and of seeing double; also frontal headaches, mental dulness, unsteadiness of gait and general nervousness. He added that it took him several hours in the morning before he could dress or feel clear as to his surroundings. No history of vomiting, loss of motor power or sphincter control. Denied venereal disease or any acute illness preceding.

Examination. Able to be out of bed, but gait was slow, hesitating, with a tendency to incline forward and to the left. Appeared very dull and fell asleep during the examination. Sensorium was definitely clouded, being particularly disoriented for time and recent events; remote memory was also impaired and thinking difficulty was very apparent. All responses were sluggish, and he handled figures slowly and incorrectly. Vision: though he complained of failing vision, he could count fingers at a distance of a foot, but was unable to read large print or to write. Fundi were reported normal. Pupils were markedly dilated, right slightly larger than the left, regular, and react well to light, but poorly to accommodation; consensual present. All extra-ocular movements slow, horizontal diplopia to the right, but no definite palsies or nystagmus. Face ironed out and mask-like, with static overaction of the whole right side; facial movements slow, but there was no definite palsy on the left. Speech low, monotonous and physically restricted. Tongue protruded in the midline, and swallowing was slow and infrequent. Motor power in both upper and lower extremities, generally but equally diminished in all segments; movements slow and restricted. All deep reflexes exaggerated; no Babinski, but definite and inexhaustible ankle-clonus on the right; abdominals active and equal. Sensation and deep sensibility unimpaired; no ataxias. Fine static tremors of the face and muscular twitchings of the right thigh and leg muscles. Temperature, afternoon and evening, ranged from 99.4° to 101°; pulse 60 at rest, but very labile on change of posture, with an occasional tachycardia. Laboratory: Blood: white blood cells, 17,400; polynuclears, 82 per cent. (eosinophiles, 3 per cent.; neutrophiles, 79 per cent.); small mononuclears,

15 per cent.; large mononuclears, 2 per cent.; transitionals, 1 per cent. Hemoglobin, 90 per cent. Spinal fluid, recumbent posture, moderate pressure, colorless, clear, 20 cells (96 per cent. mononuclears, 4 per cent. polynuclears); globulin increased; culture and stain for tuberculosis negative; Wassermann, spinal fluid and blood negative; urine negative.

Clinical Course. Temperature continued for eight days, patient becoming more dull and stupid. He complained of insomnia at night, though during the day he was drowsy, eyes shut and apparently sleeping; also complained of vertigo; no headaches. There was continued blurring of vision for near objects; right V., 20/30; left V., 20/40; form fields, media and fundi remained normal. Pupils as noted on first examination. Both internal recti failed altogether on convergence. When a strong light was placed before his eyes there was a spontaneous lateral nystagmus, with slow component to the left. Facial inequality still present and both gaze and facial expression more fixed. When standing, head and shoulders were bent forward and rigid; arms akimbo; thumbs and fingers in approximation; extended and assuming "pill-roll" attitude. Mild rigidity noted on passive movements.

A month after admission his inactivity became more pronounced and the above Parkinsonian features more in evidence, but mentality had cleared up. Was losing weight; perspired a great deal; skin oily, and oftentimes perspiration was limited to the left side of the face. He was unable to laugh, smile or be stimulated emotionally; facial expression more fixed and staring, with infrequent blinking and speech more inaudible. Rigidity definite in the neck and back, and to a lesser extent in the extremities. Tremors frequently observed in face and both lower extremities, more on the right. While sitting with the feet touching the floor there was a spontaneous ankle-clonus on the right, but examination did not disclose any other signs of pyramidal tract involvement. Gait slow, at times shuffling; was able to run slowly but without propulsion or retropulsion. His condition vacillated; at times he gave the impression of brightening up, but within a few hours he would relapse. Was seen by Lieut.-Col. Zabriskie on March 26, who pronounced the condition as a fairly typical Parkinson picture in a case of lethargic encephalitis. When noted on April 25 the condition remained stationary.

CASE III.—M. D., aged twenty-seven years. Pvt., M. G., 327 Inf. Admitted to B. H. 90 March 2, 1919, from C. H. 64, for refraction.

The eye findings were reported as completely negative and the patient was transferred to the neurological department for mental observation.

History. No history of any serious illness or trauma; venereal disease denied. In France six months; was exposed to shellfire but not affected. About two months ago had a "hard cold," but

was sick only a few days; no chills or fever. Present illness: Six weeks ago had sudden onset of headaches, generalized and severe, dizziness and this followed by gradual closure of eyelids. Felt sleepy during the day but was unable to sleep at night. This continued for two weeks and following lumbar puncture at the camp hospital, his headaches subsided; eyes opened and he found he could see well. He then developed stiffness in the left shoulder and arm; noticed a change in his speech, which he was unable to describe, and remarked especially about his inability to laugh or smile.

Examination on Admission. Complained of insomnia, "general laziness" and stiffness in the left upper limb. He held himself very rigid; trunk bent forward; gait slow but steady. Face was very mask-like; gaze fixed and blinking infrequent. Vision, pupils and all extra-ocular movements presented no abnormalities. Facial movements carried out with difficulty; unable to wrinkle forehead, smile or be stimulated. Speech was low, muffled, restricted and frequently inaudible; there was accumulation of saliva, but swallowing was infrequent and retarded. Voluntary movements slow but motor power good and equal in all extremities. Reflexes, deep and superficial, were normal. Left upper extremity flexed at the elbow; thumb and forefingers approximated. Mild rigidity on passive movements; the latter was also noted in the neck. Sensation and deep sensibility unimpaired; no ataxia. When asked to do an "about face" he did it very slowly, with a tendency to sway and fall in all directions. Tremors of both lids on shutting the eyes. Temperature normal; patient did not complain of being ill. White blood count was normal; no eosinophilia; spinal fluid, 5 cells; slightly increased globulin; Wassermann of both spinal fluid and blood negative.

Clinical Course. After a month in the hospital he showed some improvement; face still remained stolid; no paralysis. Gait slow; body bent forward, but more plastic. Eyes brighter and effort to smile partly successful. Speech still monotonous, but less restricted. Seen by Lieut.-Col. Zabriskie on March 26, at which time the case was considered as one of lethargic encephalitis and the Parkinsonian picture gradually clearing up. He continued to show a gradual improvement when noted on April 25.

In Cases II and III we have fairly well-defined Parkinsonian pictures, one remaining stationary after three months' residence in the hospital and the other gradually recovering. In both the onset was fairly abrupt, with the possibility of an acute infection preceding, though neither the inadequate histories or the clinical evidence on admission to this hospital bears out the suspicion of influenza. Further, one may note a period of a few weeks intervening between the "bad cold" and the onset of present illness in Case III, which appears to be recovering. The history of trauma in Case II, which is most marked, and showing a tendency to progression of the dis-

ease, is of special interest in that physical and emotional trauma are frequently cited as a precipitating factor in paralysis agitans.

CASE IV.—Z. G. (Italian), aged twenty-six years. Pvt. Co. H, 308 Inf. Admitted to B. H. 90, medical service, January 7, 1919, with a diagnosis of "N. Y. D.; temperature 103°." No further information.

Examination. On admission, medical: Temperature, 102°, and the most marked feature noted by the internist was "lethargy and mental torpor;" neck slightly rigid; a suggestive Kernig; abdomen somewhat tympanitic; tongue coated; bowels moved with purgation and enemata; no enlargement of spleen; a few suggestive spots on his back.

Laboratory Report. Blood culture negative for typhoid or other organisms; stool negative for typhoid (all forms); urine culture negative. White blood cells, 16,000; 60 per cent., polynuclears; 4 per cent. eosinophiles; spinal fluid, 680 cells (unfortunately no differential was made); negative stain for tuberculosis.

Clinical Course. Temperature ranged from 100° to 102°, with gradual drop to normal in about two weeks. Patient complained of pain in the right forearm; there was no tenderness. Condition was noted as improved, though after two weeks the patient required catheterization.

On February 10 a neurological consultation was requested. At this time the patient presented a well-marked chorea, generalized and involving practically the whole skeletal system, including speech and respiration. He was out of bed; fairly alert; no temperature; visual apparatus and cranial nerves satisfactory, no other evidence of sensory motor involvement. On February 14 one stool examined reported paratyphoid-B, with agglutination 1 to 2000, but subsequent examinations failed to confirm this.

History from the Patient. No family or previous history of any nervous or mental disease. Personal: No rheumatism, tonsillitis, cardiac or dental affection; no history of any other acute infectious or venereal disease. Present trouble began gradually a few days before admission here, with headaches, weakness, lassitude and pain in the right arm. Claims that memory is hazy for the first week of his illness.

Further residence in the hospital did not show any change in his choreic picture, and when examined on April 18 he still presented a well-marked, generalized chorea; right upper extremity more involved than the others. Cardiac examination did not elicit any murmurs; teeth in good condition. Spinal fluid and blood examination completely negative.

Here we are dealing with a definite picture of chorea, presenting neither hereditary nor constitutionally predisposing factors, the onset of which was fairly abrupt, during convalescence from an acute febrile disorder, the nature of which was not definitely

established, and presenting mainly a lethargic state, with meningeal involvement. The question of typhoid as an infective basis is naturally to be considered, but both the clinical and laboratory findings fail to substantiate. The Sydenham (infective) type of choreas generally show an early improvement after proper treatment, but in this instance three months have elapsed and there has been no abatement of the choreic movements. Neal¹¹ has recently reported instances presenting meningeal symptoms, with tremors occurring during convalescence from attacks, clinically influenza. In this case the influenza was apparently not considered during the febrile period, so that the etiological basis still remains in question.

CASE V.—Z. J., aged twenty-three years. Pvt., 302 Eng., Co. A. Admitted to B. H. 90, January 30, 1919, with diagnosis of N. Y. D. and reclassification; no further information.

History. No family or previous personal history of any nervous trouble, except deafness, of sudden onset, September 6, 1918, following close proximity to shell explosion; there was also ringing in the left ear, both disappearing after a month. Present illness: Sudden onset four days before admission; severe headaches; dizziness; vomiting and fall; was unconscious for about twenty-four hours. When he regained consciousness, continued to be dizzy and unsteady on his feet. Was very dull mentally and had continuous headaches; noticed a change in his speech—knowing what to say, but finding difficulty in expressing himself. Claims that his speech has continued so up to date.

Examination on Admission. At first he appeared dull and retarded, and remained in bed by choice; but when examined his appearance was more of bewilderment; sensorium, however, was not clouded. Conjunctiva and sclera were injected, but patient did not complain of being ill, nor was there any temperature. Head presented fine rhythmical tremors and there was inability to concentrate eyes upon any object, but no nystagmus. Fundi and pupils were normal; no extra-ocular limitations. Speech somewhat dysarthric, with a nasal quality. Audition good and equal. Labyrinths reported normal by the otologists. On bending head forward and backward he became dizzy. Voluntary motor power good and equal in all extremities. Deep reflexes increased; no Babinski or clonus; abdominals active and equal; sphincters intact; sensation unimpaired; gait very unsteady, requiring assistance. Marked finger to nose and hand to knee ataxia on the left; postural and deep sensibility otherwise unimpaired. Heart showed no evidence of endocarditis; blood-pressure normal. White blood cells, 8500; 2 per cent. eosinophiles; spinal fluid, 5 cells; trace of globulin; Wassermann blood and spinal fluid negative.

¹¹ Loc. cit.

Clinical Course. A month after admission, disturbance of equilibrium became more marked and practically limited to the left. On holding upper extremities forward and extended, coarse, irregular movements were noted in the whole of both limbs, but more pronounced in the left. With finger to nose test on the left there was a wild intention tremor, resembling those frequently seen in advanced cases of multiple sclerosis; he swayed in the Romberg position, with a tendency to fall toward the left. Knee-jerks on the left side greater than the right side; exhaustible patellar clonus on the left. On March 26, he still complained of dizziness, ringing in the ears, unsteadiness in gait; no gastric disturbance. Intention tremor in the left upper extremity was more marked than noted on former occasions, also adiodokokinesia; no hypotonicity.

In this case we are dealing with a cerebellar disease picture, the onset being very sudden, with unconsciousness for twenty-four hours, then dulness and continued headaches for three weeks. There was conjunctival injection, but the temperature was normal and no other evidence of an acute infection. There are several possibilities that suggest themselves, *e. g.*, sudden occlusion of the left inferior cerebellar artery, multiple sclerosis, cerebellar neoplasm and a functional condition. Endocarditis and syphilis were ruled out. Aside from the tendency to progression of the left-sided cerebellar symptoms, there was no indication of increased intracranial pressure or neoplasm, and the pronounced intention tremor and uncertain speech were the only signs pointing to multiple sclerosis. Frequent examinations convinced one that the disease was real. There then remains the question of the pathology and the etiological factor. Just what relation the concussion, followed by left-sided deafness four months previously, bears to his present condition remains unclear, as there was a period of three months intervening when he was free from any symptoms. There being no history accompanying the patient, one cannot rule out definitely a preceding acute infection. Some of the observers who had seen this case felt inclined to group it with those of lethargic encephalitis.

CASE VI.—C. A., aged twenty-three years. Pvt., Bat. B., 314 F. A. Admitted to B. H. 90, February 14, 1919, with a diagnosis of rheumatism and mental observation.

History (from patient). No family or previous personal history of any nervous or mental disorder. On February 1 there was an abrupt onset of pain in the left upper and lower limbs, with fever, but no swelling of the joints. A week later he was unable to shut the left eye properly, and at the same time he had urgency of urination, and was often unable to start a stream for as long as ten minutes.

Examination on Admission. Dull and inactive; preferred his bed; temperature normal. Complained of headaches, dizziness,

urgency, and difficulty with starting urinary stream. Pupils small, equal and regular; reaction to light somewhat sluggish, but not limited; accommodation good. No extra-ocular palsies, but definite lateral and inexhaustible nystagmus in both directions. Complete left facial palsy; tongue protrudes in the midline; speech measured and of increased nasal quality. Motor power good and equal in both upper extremities; no evidence of arthritis. Deep reflexes exaggerated; pseudo-Babinski on the right; no ankle-clonus. Abdominals not elicited on repeated examinations (level abdominal wall); cremasters present. Sensation and deep sensibility unimpaired. Spinal fluid 71, cells; lymphocytes; globulin increased; Wassermann in blood and spinal fluid negative.

Clinical Course. During further residence, facial palsy gradually disappeared; nystagmus became more jerky and exhaustible; fundi normal; no pallor of disks; speech unchanged. He developed a mild intention tremor in both upper extremities. Abdominals remained absent; reflexes otherwise unchanged; still complained of urgent and tardy urination. On March 25 there was a faint showing of the left abdominal reflexes; mentality clear.

Here was a picture of disseminated sclerosis of abrupt onset, with an early febrile period and a dull, inactive mental state. There was pain in the extremity suggesting "rheumatism" and a pleocytosis in the spinal fluid (71 lymphocytes), with no temperature or other signs of meningeal involvement. The facial palsy was fairly transient and the mental state had cleared up, but when discharged to the States, six weeks after admission, there was sufficient evidence to classify him as multiple sclerosis. Was this disease picture independent or associated with lethargic encephalitis?

CASE VII.—F. D. R., aged twenty-four years. Pvt., Troop A, Hdq. Bn., 1st Army. Admitted to B. H. 90, February 8, 1919.

History (from patient). A week prior to admission, while on an extensive motor trip, with exposure and insufficient sleep, he felt chilly, feverish and drowsy for the greater part of that week. He noticed marked blurring of vision; eyes pained him; had frontal headaches and became nervous. There was no vomiting; disturbance with gait or sphincter control.

Examination on Admission. Drowsy, but sensorium was not definitely clouded; temperature, 101°; complained of blurred vision and headaches. He displayed fine tremors of the head, with a tendency of the latter to incline to the right. There was a definite right facial palsy involving all three branches; also diminished audition and bone-conduction on the right; no earache or evidence of otitis media. Pupils markedly dilated, but reacted well; fundi normal. No extra-ocular limitations or nystagmus. Tongue protruded in the midline. No rigidity of the neck or Kernig. Motor power in the extremities unimpaired; deep reflexes increased; abdominals present; no Babinski or clonus. Sensation unimpaired;

mild finger to nose ataxia on the right. Lumbar puncture in recumbent posture; fluid under high pressure; clear; 14 cells; lymphocytes; trace of globulin; marked sugar reduction; culture negative; Wassermann blood and spinal fluid negative.

Clinical Course. Temperature continued for a few days; headaches subsided; right facial palsy began to diminish after a few weeks' residence. Vision improved; tremors of the head only occasional. After a few weeks he was discharged to the States.

This case might be considered one of ordinary Bell's palsy (chill variety) were it not for the acute infection, with the symptoms and signs of encephalitis and lethargy. The diminished auditory acuity and bone-conduction suggest cochlear involvement. There was a mild lymphocytic pleocytosis in the spinal fluid.

CASE VIII.—D. J., aged twenty-seven years. Pvt., 307 Inf., Co. E. Admitted to B. H. 90, G. U. service, March 6, 1919, with a diagnosis of cerebrospinal syphilis.

History (from C. H. No. 9, this information accompanying the patient is the best forwarded by any of the camp hospitals). Onset five days before admission, with blurring of vision and seeing double; no other complaints; denied history of lues or gonorrhea. Continued notes: Mentality unclear; eyes and conjunctivæ injected; diplopia with upward nystagmus; tongue coated; edges smooth. Heart and lungs negative; spleen slightly palpable; reflexes normal. White blood cells, 9000; culture of blood, urine and feces negative. On February 11 he required catheterization; no effort made to urinate. Mentality becoming more clouded; temperature, 99°; pulse, 74; respiration, 20. Owing to blood Wassermann, which was reported at first as anticomplimentary and a week later as one plus he was given salvarsan on February 22 and again on March 3. On March 5 condition noted as improving; pupils reacted slowly to light, also paralysis of right face.

Examination on Admission (B. H. 90). Patient appeared very dull, stupid and drowsy; though there was no actual disturbance of motor speech, he had little to say. He stated, however, that the onset of illness was gradual, extending over a week before going to the hospital. He remembers very little of the early part of his illness, except of being quite sick with fever, and that he was being bathed in bed. He now complained of blurred vision, general weakness and sleepiness; "head feeling wrong" and occasional "shaking of hands." Left ptosis; left divergence strabismus; diplopia, with or without red glasses. Pupils medium-sized, equal; left very sluggish and limited to direct light; both pupils showed very faint reaction to accommodation. Paresis of left rectus and both superior recti on conjugate movements; both internal recti failed completely on convergence; all individual extra-ocular movements slow and somewhat limited. Fundi normal. Partial paralysis of right face, lower two-thirds. Facial expression blank;

unable to smile or be stimulated. Voice monotonous and restricted. Tremors of eyelids and tongue. All voluntary movements slow and deliberate, but no actual paralysis of any muscle groups. Gait somewhat unsteady and awkward. Reflexes, superficial and deep, were normal; no temperature. White blood cells, 4050; 1 per cent. eosinophiles; spinal fluid, 8 cells; marked increase in globulin; Boveri's color test positive; blood and spinal fluid negative.

Clinical Course. During further residence in the hospital he brightened up somewhat; partly successful in attempt to smile, and took some interest in ward activities, but otherwise no change.

CASE IX.—H. J. E., aged twenty-six years. Corp., 324 Inf., Co. E. Admitted to B. H. 90, March 5, for refraction (from C. H. 64, no further information).

History (from patient). A month ago he had fever for a few days; was sent to the hospital, where he was told he had the mumps. A few days after the onset he experienced blurring of vision, diplopia and became very nervous; no headaches or vomiting. For two weeks he was unable to move tongue, so that he could not place food properly; also had swallowing difficulty and trouble with starting urinary stream. Claimed to remember all that happened during his illness.

Examination on Admission. Appeared dull, stupid and extremely deliberate in all his movements. Coöperation was uncertain, but there was no actual confusion. Complained of blurred vision, yawning and of feeling sleepy during the day. He stated that he was aware of a decided change in his speech, *e. g.*, difficulty, with full expression and occasional stammering. Pupils very dilated, the right larger than the left; both regular; reaction to both light and accommodation practically *nil*. Eye-grounds normal. Partial ptosis and divergent strabismus on the left. All conjugate movements slow and at times difficult to elicit, except upon repeated effort; no nystagmus. Speech slow, measured, monotonous and occasionally stammering. Mastication and swallowing good. Slight facial weakness on the left, tremors of lips and tongue. Motor power in extremities slow, but otherwise unimpaired. Deep reflexes absent in the upper and equally diminished in the lower extremities; superficial reflexes normal. There was no temperature; he did not complain of being ill. White blood cells, 8750; polynuclears, 75 per cent.; eosinophiles, 3 per cent. Spinal fluid, moderate pressure, fluid clear, 27 cells; mononuclears predominating; marked increase in globulin; Boveri's color test positive; Wassermann in blood and spinal fluid negative.

Clinical Course. Three weeks after admission practically little change, face becoming more dull and fixed; claimed that he was unable to laugh. Instead of being inactive, as on admission, he was now noted as restless, pacing up and down the wards, making

frequent approaches to ward surgeon and nurses, with anxious queries as to his progress and disposition. Complained of difficulty, with complete understanding of spoken language; but upon examination his orientation and his memory are good and he handles figures readily. Vision blurred; reading difficult; pupils still dilated; right, 5 mm.; left, $4\frac{1}{2}$ mm.; right reacted slightly to light but not to accommodation; left rigid. Left ptosis (partial) and left divergent strabismus of 170 degrees. All extrinsic eye movements weak and limited, but improve with repeated effort. Mild paresis of left facial muscles, including those of the forehead. Gait somewhat unsteady; mild finger to nose ataxia on the right with evident awkwardness in saluting. Occasional fine static tremors in both thigh and leg muscles.

CASE X.—E. W., aged thirty years. Pvt., 305 Fld. Sig. Bn., Co. C. Admitted to B. H. 90, February 19, 1919, first to medical, then the eye and later neurological department.

History (from C. H. 49). Admitted there January 6, 1919, with diagnosis of acute otitis media (right). Complained of diplopia to the right. On January 10, right mastoid operation performed; on January 13 developed bronchopneumonia; temperature for nine days. It was noted that he had rotatory nystagmus on the right.

Examination on Admission. Dull, painful expression; forehead corrugated; complained of headaches; double vision to the right; dizziness with a tendency to fall to the right and forward. Claimed that during his pneumonia he was "out of his head" for about two weeks. Eye-grounds and pupils normal; right external rectus palsy and pain in the right eye on lateral excursion to the right; no other cranial nerves affected. Skeletal system, motor power, deep and superficial reflexes normal. Gait slow and uncertain; swayed in the Romberg position and fell forward after doing an about-face. Slight ataxia in both upper extremities; more on the left. Normal temperature, white blood cells, 10,250; polynuclears, 70 per cent.; eosinophiles, 2 per cent.; spinal fluid cell count, 3; globulin, trace; sugar, negative; Boveri's color, negative; Wassermann blood and spinal fluid negative. Following removal of small amount of spinal fluid, he had pronounced post-puncture headaches and prostration for a week; this was unusual in the other cases. During further residence his right external rectus palsy gradually cleared up and the patient brightened up in general.

In the three cases just cited we have fairly typical examples of what has been described as lethargic encephalitis, all three being ophthalmoplegic and the first two associated with facial involvement. The most striking feature on casual observation was their lethargy, as noted in facial expression and psychomotor retardation. The course was vacillating, so that on repeated effort they were able to make a presentable appearance before a camera

and aside from strabismus a photograph failed, in the main, to bring out the expressionless features which were generally detected from a distance. All three cases were of abrupt onset, preceded or associated with a febrile clinical picture, and only the first, *e. g.*, Case VIII, could be considered as absolutely independent of a more specific infection, while the others, Case IX, complicated mumps and Case X a mastoid, with bronchopneumonia. A lymphocytic spinal fluid was definitely present in only one instance, that complicating mumps. Up to date the lethargy has been gradually disappearing, but the ophthalmoplegic and facioplegic signs in the first two cases have shown little tendency toward recovery.

Discussion. The main symptomatology and clinical course of lethargic encephalitis have been well presented in recent editorials and special articles, particularly by the *Journal of the American Medical Association*, February 8, 1919, and March 15, 1919. MacNalty, in his contribution to the British report, recognizes seven types, as follows: "Clinical affection of (a) the third pair of cranial nerves; (b) the brain-stem and bulb; (c) the long tracts; (d) the ataxic type; (e) affection of the cerebral cortex; (f) cases with evidence of spinal cord involvement; (g) the polyneuritic type with affection of the peripheral nerves."

In reviewing the 10 cases just cited, we find that the above classification may be extended so as to include some of the special systems, *e. g.*, the thalamic, the pallidal and the striorubral. The sympathetic system is probably also involved as noted in Case II. With regard to the last, the polyneuritic type, the writer deems it advisable to consider those separately until the investigation of acute infectious polyneuritis has received wider consideration. A number of these cases have been under observation here within the last few months and will be considered in another communication.

CONCLUSION. It is well to review briefly the present status of this new disease. Encephalitis may occur as a complication in any acute infection. With encephalitis, an elastic term, diffuse brain involvement is expected, and with it the naturally outstanding feature of lethargy. In 9 out of 10 cases described here there was a definite febrile period, either preceding or concomitant, including "bad cold," mumps, some form of bronchopneumonia, and in one a possible paratyphoid-B. The facilities here were such as to afford only a clinical and a rather limited laboratory study of these cases. There was an eosinophilia in the blood and a lymphocytic spinal fluid in most instances, and what bacteriological examinations were made proved negative. This much is true, that while the majority of these cases resembled other well-known diseases of the central nervous system, they were atypical in some form, either in onset, clinical course or outcome; but clinically they were encephalitis with lethargy. The study, therefore of

these cases, while bearing in mind the possibility of their being distinct infectious diseases of the nervous system, which may escape detection because of a general similarity in their clinical manifestations to well-recognized entities does not aid in establishing lethargic encephalitis as a definite clinical entity.

THE SIGNIFICANCE OF CERTAIN PULMONARY LESIONS IN RELATION TO THE ETIOLOGY OF INFLUENZA.

BY ERNEST W. GOODPASTURE, M.D.,

BOSTON, MASSACHUSETTS.

(From the Department of Pathology, Harvard Medical School.)

THE great variations in the results of bacteriological analyses of the lungs and respiratory tract of those dead of influenza have left no common ground for agreement upon any one microörganism as the etiological agent of this disease. Although in certain sections of the country evidence seemed to be strongly in favor of Pfeiffer's bacillus,¹ the failure to find this microörganism and the predominance of other invading bacteria in different localities have served in large measure to counteract what early seemed to be a confirmation of Pfeiffer's view of the importance of this bacillus in etiological relation to influenza. Nor have the carefully planned and skilfully executed experiments upon human beings in this country, designed to transmit the disease under controlled conditions, lessened our ignorance of a specific causative agent or its mode of transmission, though these experiments were carried out on a large scale and under what appeared to be perfectly adequate conditions.² There remains the pathological anatomy of the disease as a possible and perhaps lone source at the present time of some positive knowledge concerning its doubtful cause.

In the absence of bacteriological evidence for a specific etiological agent, the pathologist is confronted with the question whether there are lesions which are typical of the disease, so that one perceiving them may be assured they are the result of influenza *per se*. If this can be satisfactorily established then we have a criterion upon which to evaluate the importance and relationship of demonstrable associated infectious agents and may arrive at a tentative conclusion regarding the etiology of the disease. In the absence of such a criterion we shall probably remain, despite the overwhelming losses of the recent pandemic and our abundant opportunity for investigation, in a lack of knowledge respecting it equal to that following the last pandemic of 1889.

¹ Keegan, J. J.: Jour. Am. Med. Assn., lxxi, 1051.

² Public Health Reports, January 10, 1919, xxxiii, 34.

The prevailing opinion is, as Wolbach³ has stated, that death from influenza means death from lung complication—pneumonia in some form—and it is in the lungs that possible characteristic lesions may be found. In 1889 Leichtenstern⁴ expressed his conviction from clinical and anatomical evidences that there existed a primary pneumonia produced by the poison of influenza, and from a study of the material which I have had available from the height of the epidemic last fall and subsequently I am convinced that this is true and that the etiological factor is not any one of the numerous pathogenic microorganisms which have been cultivated from the lungs, often in pure culture, but an unknown virus which produces the general intoxication and may produce characteristic lesions in the lungs with or without the coincidence of other infectious agents.

That influenza is due to an unknown agent is a view held by a considerable number of those who have studied the disease from various points of view, but I do not find the impression of specific lesions in the lung prevalent, partially no doubt because most of our reports of the pathology of the recent epidemic have consisted of gross descriptions; and while the evidence for this opinion is not altogether above criticism, I feel that it is strong and well worthy of great emphasis.

The pulmonary lesion to which I would especially refer is a dilated condition of alveolar ducts, with a hyaline membrane partially or completely covering their walls and sometimes those of subtended alveoli. This lesion has been described already by MacCallum,⁵ Wolbach⁶ and by Burnett and the writer.⁷ The membrane is not present within all dilated air spaces and is not uniformly distributed throughout the lung. It may be most conspicuous in areas of the lung which contain least exudate. It is present most conspicuously in acute pneumonia of short duration accompanying influenza. The membrane is irregular in thickness, sometimes stratified, with occasional cells within narrow clefts. It is usually thickest over the angles of the wall, but may completely fill an alveolus. At its margins it may be continuous with strands of fibrin, though it does not give the staining reactions for fibrin. In some preparations it appears to be composed almost entirely of fused necrotic mononuclear cells, in others of coalescing strands of fibrin, and probably always represents a mixture of the two. Associated with this lesion are evidences of injury and acute reaction, such as hemorrhage, edema, cellular and fluid exudate and focal necrosis of alveolar walls, each of which varies in extent in

³ Johns Hopkins Hospital Bulletin, vol. xxx, 338, 104.

⁴ Specielle Path. u. Ther., Nothnagel, iv, No. 1, p. 83.

⁵ Jour. Am. Med. Assn., lxxii, 10, 720.

⁶ Loc. cit.

⁷ Goodpasture, E. W., and Burnett, F. L.: U. S. Naval Medical Bulletin, xiii, 2, 177.

different cases. The hyaline membrane is always associated with dilated alveolar ducts. This lesion is not to be considered specific in the sense that it contains specific elements in its composition, for so far as has been demonstrated it represents a reaction to injury by elements normally participating in inflammatory processes. The evidence for its specificity depends solely upon the constancy of its association with influenza and its absence in other types of pulmonary inflammation known to be of a different nature. So far as I am aware it has not been described in any inflammation of the lungs other than that accompanying influenza. Wolbach describes it as constantly present in the cases of influenzal pneumonia studied by him, and considers its presence "the one distinctive feature in the pathology of influenzal pneumonias, and its constant occurrence indicative of the entity of the initial lung infection." I found it present in all of the cases of influenzal pneumonia which died within a few days after the onset, and in 70 per cent. of the total number of pneumonias accompanying influenza examined during the height of the epidemic. Failure to find it only occurred in cases of outspoken secondary lobar pneumonia and streptococcus infections with extensive necrosis of the pulmonary tissue. MacCallum describes the same lesion as an accompaniment of certain more acute pneumonias following influenza, which he considers due to pneumococci. He does not record the frequency of its occurrence, but since he recovered in the great majority of his cases, pneumococci in pure culture or predominantly, presumably he found it often.

While this lesion is thus seen to have been demonstrated with great frequency in cases dying with pulmonary lesions accompanying influenza during the height of the epidemic, and though it is probably not present in association with any other disease, its presence is, nevertheless, not dependent upon any one demonstrable micro-organism, for in the cases studied by Wolbach at Camp Devens, Ayer, Mass., and at Boston, and in those observed by me at the U. S. Naval Hospital, Chelsea, Mass., it was more commonly associated with Pfeiffer's bacillus, often in pure culture; and in the three groups of cases investigated by MacCallum at Camp Lee, Camp Dix and at the Johns Hopkins Hospital, it was accompanied by infection with pneumococci in pure culture or predominantly. Since my former report⁸ I have encountered the same lesion in three individuals dying from clinically typical influenzal pneumonia, from the lungs of whom hemolytic streptococci were grown in pure culture, and from two others in whose lungs no microorganisms could be demonstrated either by cultural methods, animal inoculation or microscopic examination of the tissues.

From this evidence it may safely be stated that the lesion characterized by a hyaline membrane as described, situated upon the

⁸ Loc. cit.

walls of dilated alveolar ducts and adjacent alveoli, is not a reaction typical of the presence of any one of the various demonstrated microorganisms with which it may be associated; and it may be present in the lungs of persons dead of influenza, in which no microorganisms are demonstrable by the ordinary methods.

Two explanations for its presence occur to me. First, that it represents an inflammatory reaction which under circumstances of lowered resistance, such as occur with influenza, may be brought about by any pathogenic microorganism or toxic agent that may gain entrance to the lungs. Even if this explanation should prove to be the true one the lesion itself is no less specific, for it is the circumstance of an attending influenza that lays the conditions for its formation. The explanation, however, does not appear to be a good one for the reason that we do not find the membrane present in pulmonary inflammations due to pneumococci, streptococci or influenza bacilli unassociated with epidemic influenza. Furthermore, none of these microorganisms or other demonstrable bacteria are associated in any intimate way with the lesion; in fact, whatever the attending infection, this membrane is usually bacteria-free, and, as will be described later, it may be present without demonstrable associated infection. I have gained the impression that it is formed before the fluid and cellular exudate predominates in the inflammatory process, for it is sometimes found most abundantly at the margin of the more firmly consolidated regions and may be less in evidence where the fluid and cellular elements are most conspicuous.

The second explanation is that it represents an inflammatory reaction to an unknown causative agent of influenza which injures the walls of alveolar ducts at first in a relatively mild degree, causing desquamation and necrosis of epithelial cells and an exudate of large mononuclear cells with some fibrin and serous fluid, all of which become partially concentrated by the inflowing and outflowing respiratory currents of air until they coalesce and adhere to the injured walls. The more extensive injury and reaction, with focal necrosis, hemorrhage and fluid exudate, occur later with the increase in the intoxicating agent and with additional injury brought about by secondary infection of any kind.

Supporting this view it seems to me are the facts that this lesion, so far as we know, occurs only in the inflamed lung of those infected with influenza, the diagnosis of influenza being based upon the pandemic character and extreme infectiousness of a disease of certain clinical manifestations; that it is not exclusively associated with any one microorganism, and the microorganisms with which it may be associated do not produce it in inflammations of the lungs other than those accompanying influenza; that it may be present in typical form in lungs in which no organisms are demonstrable by ordinary methods; and, finally, of those dying of pulmonary

lesions accompanying influenza it is demonstrable in a large proportion of cases.

In emphasizing the importance and apparent specificity of the hyaline membrane upon the walls of dilated alveolar ducts, I do not intend to imply that this is the only lesion produced by the virus of influenza within the lungs; in fact, I would attribute in large part to the action of influenzal virus, *per se*, the extensive injury to the pulmonary tissues with resulting hemorrhage, necrosis and acute exudate in cases dying shortly after pneumonia became manifest, and in the lungs of which few or no microorganisms are demonstrable within the alveolar tissues. Yet it is obviously impossible to determine what degree of this injury might be due to the action of secondary invading microorganisms if they are present, for such injury and inflammation is of a general kind to which any one of the infectious agents might contribute in any degree.

The above-described lesion, then, in man, I believe, may be considered as peculiar to the pulmonary inflammation of influenza, and none of the microorganisms demonstrated in the lungs is essential to its production. These propositions carry the inference that it is a reaction to a specific agent or set of conditions which are present only in this disease. To establish its complete independence of the microorganisms which have been demonstrated in the lungs, we should hope to find it present in certain instances of influenzal pneumonia in which demonstrable microorganisms are not found. At the U. S. Naval Hospital, Chelsea, Mass., we had the opportunity to study two such cases, though I have not found similar instances recorded elsewhere. The prime significance of these observations makes it important that they be described here. The hyaline membrane was present in typical form in each of these lungs, though no microorganisms have been demonstrated in them by culture, animal inoculation or patient study of strained smears and sections by methods which, in other cases with positive cultures, have easily revealed the type of microorganism grown from the lung.

The first instance was that of a large, robust young man who contracted influenza during the height of the epidemic in September, 1918. Clinically, he presented the usual evidences of the disease, and on the fifth day after the onset signs of consolidation in the lungs were first detected. These rapidly spread, intoxication increased and he died on the seventh day after his initial symptoms. Postmortem examination was made two hours after death. Grossly the lungs presented the usual edematous, hemorrhagic, emphysematous condition constantly found in the very acute cases. Cultures were made from both lungs by sterilizing the pleural surface and inserting deeply a capillary pipette withdrawing from various portions a few drops of fluid exudate. This was planted upon whole blood-agar plates, such as had been used successfully in previous cases and which had been properly tested. All of these cultures

proved sterile as well as cultures from the heart's blood. Smears from various portions of exudate, stained with Loeffler's methylene-blue and other routine stains, were likewise negative for microorganisms. Thin paraffin sections from various regions of the lung were fixed in Zenker's fluid and stained with eosin and methylene-blue, Gram-Weigert and by the anilin-carbol-fuchsin method devised by me to demonstrate Pfeiffer's bacillus in tissues.⁹ No organisms were found excepting a few intracellular Gram-positive cocci within the bronchial exudate.

Microscopically the lungs showed an extreme degree of injury and destruction of alveolar walls with hemorrhage, edema, a little fibrin and scant cellular exudate. The alveolar ducts were dilated and on the walls of some of them was found the typical hyaline membrane.

The second case was a more unusual one, being the only instance of its kind observed by us, and I have not seen a similar one described.

The patient was a young man, aged eighteen years, who was admitted to the Naval Hospital with a typical attack of influenza. He was sick three days before admission. His illness continued during the last four days of September and first three days of October, 1918. His temperature was 103° F. on admission and fell the following day to normal. No clinical evidence of pneumonia was discovered during this attack. Three days later he was discharged from the hospital. Afterward he at no time felt well. He went home for a few days on furlough, then returned to his work as a hospital-corps man. His cough persisted; he lost weight and gradually became weaker until he had to report to the sick bay. From there he was sent again to the Naval Hospital, Chelsea. He reëntered this hospital November 6, 1918, with cough, pain in the chest, bloody sputum, anemia and signs of bronchopneumonia in the right lower lobe. His temperature on admission was 100.4° F.; pulse, 120; respiration, 28. He expectorated quantities of bright red blood. The pneumonia speedily became massive and spread to the left lung. The clinical records state he became septic, dyspneic and raised much bloody sputum. Serum from patients convalescing from pneumonia following influenza was administered without relief of symptoms. He died on November 9, three days after admission. White blood count on the day after admission was 17,600. Differential count: polymorphonuclear leukocytes, 58 per cent.; mononuclears, 40 per cent.; eosinophiles, 2 per cent. Urine showed a trace of albumin.

Postmortem examination made two hours after death revealed a pale, anemic, moderately emaciated body. There were 200 c.c. of clear fluid in right pleural cavity. The pleural surfaces were dark purple in color and for the most part smooth, though here and there

⁹ MacCallum, W. G.: Jour. Am. Med. Assn., No. 10, lxxii, p. 720,

they were slightly thickened and covered by fine granules of fibrin. The right lung was completely consolidated and very firm. On section the cut surface was brick red in color and hemorrhagic fluid could be expressed and ran out of cut bronchi. Hemorrhage instead of edema was the predominant feature. In the left lower lobe patches of similar hemorrhagic consolidation were present. The lung gave the impression of having been injected with blood through the bronchi so that all the air spaces were filled. On closer inspection dilatation of terminal air channels was evident and the alveolar ducts were outlined by gray lines, and there were minute gray points everywhere as if many alveoli were filled with fibrin. Cultures taken from the various lobes, spleen and heart's blood were sterile; numerous smears showed no organisms. A guinea-pig inoculated intraperitoneally with ground lung died in forty-eight hours, but only a clear sterile peritoneal fluid was found, and its blood culture was sterile.

The spleen of this man was a little smaller than normal and quite pale, yellowish gray. On cut surface yellowish and gray opaque foci up to 2 mm. in size were evident. The kidneys were normal in size, but there were a few small hemorrhages in the cortex and moderate edema. Here and there in the wall of the small intestine were bright red hemorrhages measuring 1 or 2 mm. in diameter. The other organs presented nothing of special interest. The heart and valves appeared normal.

Microscopically sections of the lung show a tremendous amount of blood in the air spaces. Alveoli and terminal bronchioles are filled with erythrocytes. There are innumerable foci composed of polymorphonuclears, fibrin, large mononuclear cells and disintegrating hyaline material scattered through the sections. These foci often indicate small areas of necrosis of the alveolar walls. Here and there alveoli are filled with plugs of fibrin. In certain areas there is a great abundance of hyaline material upon the walls of dilated alveolar ducts and in alveoli. This appears to be formed largely of coalesced necrotic mononuclear cells with small amounts of fibrin. Its appearance and arrangement is in every way typical of that found in the lungs of more acute cases of pneumonia accompanying influenza. The inflammatory process in the lungs appears to be subacute, with a terminal exacerbation. In certain alveoli the exudate has undergone organization, and some bronchioles are filled with plugs of organizing exudate. Both larger and smaller bronchi appear normal. The epithelial coat is intact and no exudate excepting erythrocytes and some coagulated albumin, is present. Patient search has revealed no microorganisms whatsoever in this lung.

The spleen on section shows numerous foci of necrosis occupying especially the areas of former Malpighian bodies. Necrotic cells,

polymorphonuclears, strands and networks of fibrin compose these areas, situated about the small arteries.

The kidneys show a glomerular nephropathy with a fibrinous exudate in Bowman's capsule and cellular proliferation of glomerular tufts; some urinary tubules are filled with erythrocytes. Sections through the hemorrhagic points in the intestine show focal lesions in the wall of arterioles, with fibrinous exudate and a few polymorphonuclears. No microorganisms have been demonstrated in any of these lesions after repeated attempts.

While the presence of lesions in the kidney and spleen may be regarded as evidence that this case does not represent a pure influenzal infection, still the pathology of the lungs and the absence of demonstrable infectious agents to account for the acute pulmonary lesions seem to overbalance them in favor of influenza as at least the primary and predominant infection. And it does not seem inconceivable, although rare, that the virus of influenza might persist within the body for six weeks with the production of lesions of the character found in this man.

The clinical histories of these two cases leave little doubt that they are primarily instances of influenzal infection. Both contracted the disease during the height of the epidemic, and manifested typical clinical courses. The first died of his initial infection; the second, though combating successfully for a time his original attack, never quite recovered, and died of the disease a month later. Both presented lesions in the lung which are to be regarded as peculiar to the pulmonary inflammation of influenza, yet no microorganisms were demonstrated by the usual methods in the lungs of either. In the absence of any known infectious agent one is led to the conclusion that they represent instances of fatal influenzal pneumonia, caused by an infectious agent of which we are totally ignorant, and without secondary invasion of the lungs by any of the pathogenic bacteria commonly found associated with it. Granting that they are examples of influenzal pneumonia, the presence of the hyaline membrane on the walls of dilated alveolar ducts is further evidence of the specificity of this lesion and its independence of secondary invading organisms; or from analogy to other cases the presence of this membrane indicates that the pulmonary inflammation is that of influenza, though no bacteria are found. The pathology of the lungs in the second case is strongly suggestive of a persistence of the infecting agent in this tissue from the time of the initial attack one month previously, with a final and fatal exacerbation.

In interpreting these observations one feels justified in formulating the opinion that influenza is a distinct disease, recognizable clinically only by its epidemic proportions and extreme infectiousness, characterized pathologically by peculiar lesions in the lung, and caused by an unknown virus which gains entrance through the respiratory tract.

ROENTGENOLOGICAL DETERMINATION OF PULMONARY TUBERCULOSIS.

By F. E. DIEMER, M.D.,

PORTLAND, OREGON,

AND

I. H. CRAMER, M.D.,

PORTLAND, OREGON.

A ROENTGENOLOGICAL study of several thousand chests at Camp Lewis, Washington, has prompted certain definite conclusions which are set forth in this article. In the neighborhood of 600* cases of tuberculosis were studied by the roentgen staff. In approximately 300 cases the clinical and physical findings were recorded, and in the small percentage in which laboratory findings were positive that fact was noted.

Lack of time did not always allow of the most careful clinical study, but a sufficient number of each type were studied to permit correlation of physical findings with roentgen observations. Certain definite presentations on both plate and screen were positively proved to be tuberculous by the finding of the bacillus to make the diagnosis by roentgen study alone fairly sure in all types and stages.

The study was made by screen, single plate, stereoscopic plates and by combination of plate and screen. The most perfect plate and the most brilliant screen are absolutely essential. It is sometimes necessary to make many plates of a chest in order to bring out the definite characteristics, using different degrees of penetration and different angles and position of exposure. Single or even double screen plates or films do not present the necessary brilliant contrast and detail. The Coolidge tube will not make a diagnostic chest plate and the gas tube must be used.

In plate interpretation, every shadow, configuration and position must be understood and carefully studied. The visibility of the bronchovesicular tree must be appreciated for height, age, weight and occupation. The differentiation between peribronchial infiltration and thickening must be understood. The exact difference of degree of illumination and radiability is very important.

Abnormal configuration of the heart silhouette suggests valvular disease, which might account for abnormal lung shadows. Circumscribed areas resembling calcification are seen distributed throughout, particularly the lower quadrants, the result of dilated vessels in mitral disease.

Position and configuration of the diaphragm conveys much infor-

* We wish to express thanks to Drs. R. D. McRae, J. M. Moore, W. C. Smallwood, T. G. Clement, and the members of the Tuberculosis Examining Board for their assistance and coöperation in our study of the cases.

mation. The degree of parenchymal involvement is determined by the diaphragmatic position in deep inspiration. Previous pneumonias often leave pleurodiaphragmatic adhesions.

The condition of the hilus is extremely important. Infiltration, calcification or exaggeration results both from pulmonary infection and from abdominal infection, and the differentiation must be made from the general and minute lung picture.

The location of calcification areas throughout the lung fields is very suggestive. Diffused distribution suggests healed disseminated tuberculosis. A few areas in the lower quadrants designate the location of the primary tubercle, while those in the upper quadrants are more significant of quiescent, inactive or chronic active tuberculosis. The configuration and radiability of calcification areas suggest the activity of the process. Dense areas, undoubtedly lime salts, that are not discrete and where borders are not clear cut but blend gradually with the surrounding lung tissue, particularly if the center presents a delicate mottling (suggesting that the interstitial tissue remains intact), indicates that the process is active and the caseation area has not completely become calcified.

There are many pathological conditions which involve the lower quadrants but very few which involve the upper quadrants. If abnormal shadows are found in the upper quadrants the first thought is tuberculosis, although the pneumonias and various other conditions (which do not present the typical tubercular shadows) must be differentiated. If abnormal shadows are seen in the lower quadrants a non-tuberculous process is suspected.

Conclusions with explanation of modifications follows:

1. The definite determination of pulmonary tuberculosis by means of roentgen study alone in particularly every stage is possible. The stage and the activity of the process are not as definitely established by roentgen study alone as by physical examination alone, but a combination of both is decidedly more reliable than either alone.

2. The stage of an excavation is readily determined.

3. There are distinct roentgenological pathognomonic indications of pulmonary tuberculosis.

4. The exact involvement is more readily made out by roentgen study. Much assistance is furnished the clinician in regard to prognosis.

The value of thorough roentgen study of the chest in tuberculosis varies slightly in different stages and forms of the disease.

1. In the incipient stage the roentgen study is of undoubted value, definite haziness, peribronchial infiltration and a marked degree of lessened illumination upon coughing or deep inspiration being determined on plate and screen. These roentgen indications appear as soon as does the clinical evidence.

In the cortical type the clinical findings are exaggerated while the roentgen evidence is not pronounced, but in the peribronchial

and bronchopneumonic tuberculosis the findings are reversed. In these latter types there is apparently a hilus tuberculosis and the infection extends bronchogenetically, usually along the course of the vertebral, first intercostal and second intercostal bronchi. Apparently the primary tubercle originates as follows: The bacilli are carried deep into the distal bronchiole by inspired air. The thin wall of the bronchiole offers little resistance to the infection and caseation and destruction take place. After calcification these areas are readily seen and are, for the most part, located in the lower quadrants (because of greater expansion and consequently the entrance of more air). The infection then extends along the lymphatics to the hilus, and if not arrested there proceeds peribronchogenetically to the apices, producing a peribronchial involvement in its incipiency. In practically every case of chronic tuberculosis the path of travel from the lower quadrants to the hilus and thence to the upper quadrant can be made out on the plate. Many chests have been observed in healthy subjects, in which the primary tubercle and the hilus calcification can be seen. Often the bronchi along which the lymphatic infection travels will show numerous small calcification areas, and a beaded appearance is presented. If the primary infection is in the abdomen no primary tubercle is found, but distinct hilus infiltration or calcification is observed. In massive hilus tuberculosis the infection must of necessity reach the bronchial glands by one of these two routes.

2. After fibrous infiltration takes place the roentgen indications are almost pathognomonic, particularly for the disease, but also for activity to a slightly lesser degree. Even before mediastinal retraction appears the evidence of fibrosis is apparent because of the extensive bronchovesicular thickening, the delicate strand-like shadows and the further decrease in radiability. After organization of the fibrous process, with more or less retraction and the appearance of compensatory emphysema, the diagnosis is more readily reached; but activity is less easily determined. At this stage the process is very liable to become quiescent. The physical findings are then very indefinite indeed.

3. The caseation areas are not definitely made out, but after calcification takes place, whether with marked or little fibrosis, the diagnosis is definite for tuberculosis and the degree of activity is suspected.

4. In the ulcerative type the excavations are classed as acute, subacute chronic and healed, and their age determined as follows:

(a) The acute cavity does not present a definite, distinct capsule; its configuration is not oval or circumscribed but more likely to be irregular; the radiability of its center is the same or less than the surrounding parenchymal shadows; it does not illuminate upon the patient coughing and there is no distinct drainage sinus leading toward the hilus.

(b) The subacute cavity begins to assume a definite circumscribed form; its capsule is readily seen, but is as yet not as definitely marked as in the chronic cavity; it usually contains a small quantity of fluid in its dependent portion, which indicates that drainage has not been perfected; above the fluid level the radiability is increased, indicating the presence of air. As yet the cavity does not illuminate upon coughing nor does the drainage sinus present as distinctly as later.

(c) The chronic cavity presents distinctly a fibrous capsule; it is oval or circular in shape, flat or spherical in configuration; it contains no fluid if the patient is examined late in the morning or in the afternoon; it illuminates brilliantly upon coughing and the thickened drainage sinus is readily made out.

(d) Healed cavities are not often seen; they present a very marked, thick capsule; contain no fluid; are very small in area and illuminate only slightly upon coughing. The drainage sinus is narrow, but its borders are very sharply outlined, indicating that no perisinus parenchymal involvement is present.

Differentiation between ulcerative excavations and the small emphysematous excavations must be made. These latter appear in the late fibrous stage and result from a constriction of the bronchioles from contraction of the fibrous tissue. The mechanics apparently is the same as in bronchiectasis, an increase of air pressure distal to the point of lumen-narrowing, which finally ruptures a terminal air sac and produces a small excavation. These excavations are multiple throughout the tuberculous area. No capsule is present; the outline is irregular; they illuminate upon coughing and contain no fluid in their uninfected stage. Clinically the isthmus is normal or widened; resonance is increased or normal; bronchovesicular breathing marked; harsh, prolonged expiration; and rales depending on the activity of the tubercular process. In all probability ulcerative cavities are often formed by infection of one or more of these emphysematous excavations. This has not been proved. In our experience only a small percentage of excavations were detected by physical examination even after being located by roentgen study. Probably the best indication of the existence of a cavity in the subacute and chronic stage, particularly after liquefaction of its contents, is a large amount of expectoration (2 to 4 ounces daily), in which the tubercle bacillus is demonstrated.

5. In the deep peribronchial type of tuberculosis, without parenchymal involvement, a distinct circumscribed peribronchial thickening will give way to an indication of peribronchial infiltration, and the bronchovesicular tree then presents a fuzzy rather than sharply delimited appearance. Extension of the process is then rapid, and there is an extreme lack of illumination on the plate, presenting a delicately mottled increase in density.

6. In massive hilus tuberculosis the roentgenologist is on a par with the clinician; its existence and activity can only be guessed.

Before calcification no definite indications are seen, either by screen or plate; after lime salt deposit, visualization of the area is obtained and quiescence suspected if the calcification is uniform in radiability and sharply demarcated, and *vice versa*.

7. In disseminated tuberculosis the lung picture presents nothing definite unless healing takes place, when many small areas of calcification are seen distributed throughout both lung fields, the greater number in the lower quadrants.

8. Probably all types of pulmonary tuberculosis can be classed, strictly speaking, as a true bronchopneumonia during a certain stage, but the roentgenological presentation of an acute tuberculous bronchopneumonia, in which the parenchymal involvement is peribronchial, superimposed upon a chronic fibrous process, is distinctive and typical. True, it is impossible by any means to differentiate the acute pneumonic process, especially if the tubercle bacillus is found in the sputum with an abundance of streptococcus, particularly the hemolytic type. Streptococcus infection of the lung parenchyma often involves the upper quadrants, both unilateral and bilateral, and is extremely difficult to distinguish from a tuberculous infection.

An old quiescent lesion which becomes active following measles, pneumonia, etc., is inclined to involve either both lungs in their entirety, the opposite lung only, especially in its lower quadrant, or the lower quadrant of the same lung in which the lesion is located.

PATHOGNOMONIC INDICATIONS. To the uninitiated there are two pathognomonic signs of pulmonary tuberculosis:

1. Lime-salt deposits in the upper quadrants, which do not necessarily indicate activity.

2. The cavity which indicates activity in the large percentage of cases.

Calcification areas, wherever located in the lung, in the vast majority of cases indicate that at some time there has been an active tuberculous process, but those of the lower quadrants are rather incidental, as healing usually takes place and the process stops at the bronchial glands. In the upper quadrants they indicate that the patient has a true, dangerous tuberculous infection which is either healed, quiescent or more or less active. If in addition there are indications of fibrosis, with no emphysema and little or no mediastinal or chest-wall retraction, activity is indicated. If clear, irregular emphysematous areas are interspersed, with more or less retraction, and the calcification areas are clear-cut and uniformly dense, the process is probably quiescent, chronic-inactive or healed. Differentiation from lues, the fungi infections and the pneumonias can be made without difficulty, but only after observing many cases.

Excavations are unmistakable if studied by both plates and screen. Activity is at once established, the differentiation from non-tuberculous lung abscesses presenting no very great difficulty. The

tuberculous cavities, except in a very small percentage, are found high in the upper quadrants and are often multiple or bilateral, while lung abscesses are practically always found in the body of a lobe and seldom multiple or bilateral. In our series 4 cases presented tuberculous excavations in the lower lobes. Three cases of multiple pulmonary abscesses were detected in a series of over 2000 cases of pneumonia studied by roentgen rays. These abscesses were either filled with broken-down, semisolid tissue or with pus, the patients not living sufficient time for but few of them to establish drainage or air to collect above the fluid level. Lung abscesses invariably in a few days present a collection of air above the fluid level. The same is true of tuberculous cavities, but the surrounding lung shows unmistakable evidence of peribronchial thickening, fibrosis and other signs of tuberculosis, depending upon the stage of the process. A non-tuberculous cavity tends to heal if adequate drainage is established, and is seldom seen when empty, while the tuberculous cavity does not as often completely heal and is usually empty.

Other conditions to a lesser degree pathognomonic are as follows: Fibrosis, retraction of the trachea, mediastinal contents, heart and chest wall, a decided lack of illumination of one or both upper quadrants on deep inspiration or coughing before the screen, and a lessened radiability, either uniform or delicately mottled on the plate; abnormal presentation in the upper quadrants if there is a hanging "dropped" or very small heart silhouette; or if the diaphragm on the corresponding side is in partial expiratory position or its excursion is impaired on deep inspiration. Any abnormality found in the upper quadrants should prompt the roentgenologist to suggest the probability of tuberculosis unless definite indications of another process are certain.

An interesting phenomenon seen in the more chronic emaciated cases is the difference in radiability of the pectoralis muscles, those on the affected side not being so dense and distinct.

In regard to the extent of the process and the prognosis much assistance is furnished the internist. Only a small percentage of cavities are diagnosed by the internist unless he be particularly adept. The size of the cavity and its stage can hardly be estimated without the roentgen rays. Chronic-inactive types present few physical signs, but the process in its fullest extent is visualized by both screen and plate. In the incipient stage, certain physical signs, rales and breath-sound changes are often more definite than the extent of the process would indicate.

The roentgen study is indispensable in treatment by artificial pneumothorax. Adhesions between the visceral and parietal pleura defeat the object, preventing compression of the diseased area. These adhesions will often be separated by more pressure. The roentgen study indicates when lung collapse goes on to lung compression and the amount of pressure necessary to separate the adhesions.

REVIEWS.

A TEXT-BOOK OF BIOLOGY. FOR STUDENTS IN GENERAL, MEDICAL AND TECHNICAL COURSES. By WILLIAM M. SMALLWOOD, M.D., Professor of Comparative Anatomy, Syracuse University. Third edition. Pp. 360; 235 illustrations and 8 plates in colors and monochrome. Philadelphia and New York: Lea & Febiger.

THIS is a modern college text-book, designed to supplement the laboratory courses in elementary zoölogy and botany. With the raising of entrance requirements to medical schools there have appeared books adapted to the new regulations. Perusal of this text will serve to give a good conception of what is being taught to the premedical student in general biology. Part I consists of information about the plants and animals studied in the laboratory, *e. g.*, paramecium, hydra, earthworm, clam, crayfish, bee and frog of the animal kingdom, and pleurococcus, yeast, algæ, fungi and trillium of the vegetable kingdom. Then follow chapters on such topics as biological factors in disease, evolution, variation and heredity, parasitism and symbiosis and animal behavior and its relation to the mind. In these are introduced many illustrative cases, which are of interest to the medical man and which should be important in molding the viewpoint of the student preparing to enter on the study of medicine. Thus under heredity is introduced the genealogical tree of the Mampel family, showing the sex-linked character of hemophilia, while a diagram and photograph serve to show how sewage pollution of an oyster bed led directly to the participants at a banquet becoming the victims of typhoid fever. Although laboratory work is the main method for the training of the student in the sciences, such a book as this must serve to stimulate his interest.

W. H. F. A.

APPLIED ANATOMY AND KINESIOLOGY. By WILBUR PARDON BOWEN, M.S., Professor of Physical Education, Michigan State Normal School, Ypsilanti, Michigan. Second edition. Pp. 334; 197 illustrations. Philadelphia and New York: Lea & Febiger, 1919.

THIS volume is one of the Physical Education Series edited by R. Tait Mackenzie, Major, Royal Army Medical Corps, and pro-

fessor of physical education and physical therapy, University of Pennsylvania, Philadelphia. Kinesiology is the science of bodily movement and includes a study of the principal types of muscular exercise. Applied anatomy here has reference to the application of such study to the work done by muscles and the effect upon them of such work. Applied anatomy, without any associated and qualifying term, by custom, has come to be used in reference to the more general application of our knowledge of anatomy to the everyday practice of physicians and surgeons, especially to that of the surgeon. While the book is of interest to the average physician, it is probably of more interest to and intended for instructors in physical education. It involves a comparative study of the anatomy, physiology and mechanics of muscles as well as their pathology, therapeutics and hygiene. In undertaking this physical-education series the editor aims to place physical education on the plane that its importance and dignity demand. The general principles of muscular structure and action are considered, the effect of the muscles on the bones and the relation of the nervous system to the muscles. Each muscle in turn is studied individually as well as the various mass actions in the different parts of the body in relation to gymnastic exercises, games and sports, etc. The special knowledge here offered is of much service now in the treatment of the crippled limbs of our returned wounded soldiers. T. T. T.

MESS OFFICERS' MANUAL. PREPARED BY SEVERAL OFFICERS OF THE DIVISION OF FOOD AND NUTRITION OF THE MEDICAL DEPARTMENT, U. S. ARMY. Pp. 192; 3 illustrations. Philadelphia and New York: Lea & Febiger, 1919.

A MANUAL which presents a myriad of facts concerning all phases of mess management in logical order, it is a book which would be of assistance in managing the messing of any number of people. However, this is not a book which can be handed to an untrained individual, for the use of terms dealing with physiological chemistry involves an otherwise simplified presentation of a great need which this book fulfils. W. B.

DE L' ORTHOPÉDIE INSTRUMENTALE. By DR. GABRIEL BIDOU. Pp. 132; 20 figures. Paris (no publisher's name), 1919.

THIS little book treats in an elementary way of prosthetic appliances for cripples, paralytics, stiff joints, etc. It comes furnished, with a ready-made "review," on the stationery of the "Orphan-Apprentice School," 40 rue La Fontaine, Paris; the author's card

is attached, with the manuscript notation that he will be grateful for the publication of this "vient de paraître."

The author discusses at some length the mechanics of locomotion, and while this portion of his work is of interest, there is little that is new suggested either in theory or practice. He employs an apparatus with a shoulder strap to flex the impotent thigh upon the trunk, and for artificial limbs prefers the use of celluloid sockets, with cords to manipulate the joints by leverage over pulleys of different diameters. It may be said that the apparatus usually employed in this country is simpler in construction and equally efficient.

A. P. C. A.

MILK. By PAUL E. HEINEMAN, Ph.D., Director of the Laboratories of the United States Standard Serum Company. Pp. 684; 172 illustrations; Philadelphia and London: W. B. Saunders Company, 1919.

THIS book is a rather important addition to medical literature. As far as the knowledge of the reviewer goes it is unique in that it is the only volume devoted entirely to the subject of milk. It is undoubtedly of importance that milk should be carefully considered, and it behooves the medical profession to be possessed of complete understanding of what is and what is not sufficiently good milk for human use. In order to appreciate this question, milk must be followed from the time of its production to its consumption, and in Dr. Heineman's book we find such consideration.

In the first chapter is an interesting historical review of milk and milk products. Butter was used at least as early as 2000 B.C., and the churn has been a constant companion of man throughout his forward struggle. All that is known about the physiology of lactation will be found in a chapter on that subject. The space does not allow a critical analysis of the pages devoted to the physical properties of milk, the physical and chemical examination and the general chemistry, suffice it to say that they are unusually complete.

While adulterations and preservatives are no longer commonly used, they are not forgotten, and their detection by means of tests is outlined. Enzymes in milk and the transmission of toxins through milk occupy two short chapters. Very important is that section of the book devoted to the microorganisms in milk. Here the whole subject of the care of milk enters in. The cow, the dairy, the method of milking, the shipping and numerous other phases of getting clean milk and keeping it clean are studied. The illustrations are plentiful and good in this connection. Milk-borne infections are of enough importance to demand a long chapter. A chapter on pasteurized milk follows immediately after one on certified milk. The reviewer suggests that certified milk, while undoubtedly the

best milk to use, should not always be used unpasteurized. This is especially true in the summer when there is any question of delayed or imperfect transportation. Then milk should be pasteurized even though produced under ideal circumstances.

An all-too-short chapter is included on milk in relation to infant-feeding. This is ably written by Drs. Abt and Levinson. The author does not forget the milk products, butter and cheese, and accords them each a chapter. One also finds several other subjects considered, such as ice-cream and ices, condensed milk and milk from mammals other than the cow.

A. G. M.

PROBLEMS OF FERTILIZATION. By FRANK RATTRAY LILLIE, Professor of Embryology, University of Chicago. Pp. 278; 18 illustrations. Chicago: University of Chicago Press, 1919.

FERTILIZATION is here regarded as a reaction possessing very definite biological and biochemical characters. In this volume all available experimental data on these characters are collected by a leading investigator in this new field, together with a full discussion of divergent views. The forms used for studying fertilization problems have been mostly marine invertebrates, where both eggs and sperm are shed into the sea-water and where the process of the union of the cells can be followed in great detail and where experimental alterations in chemical constitution, temperature, etc., of the surrounding medium can be readily introduced. The bulk of the work has been done by Americans, and for the most part carried out at the Marine Biological Laboratory at Wood's Hole. The author believes that the head of the sperm contains all the substances necessary for fertilization in spite of the fact that in many forms the entire sperm enters the egg. Although motile activity of the sperm seems necessary for entrance into the egg, it is found that not all sperm which still show motility have fertilizing power. Because Waldeyer found spermia retaining their motility in the human genital tract for three weeks, it has been assumed that they also retained their fertilizing power for that period. But these experiments on lower forms bear out the more recent view of Bryce and Teacher, that about forty-eight hours is the limit of time that human sperm retains the power to fertilize. Most interesting are the author's views on egg secretions and their effect on the activity of the sperm. The effects of the presence of the eggs on the sperm are activation, aggregation and agglutination. An egg secretion, which he names fertilizin, can be dissolved from the egg, and this watery extract produces the same effects as the presence of the eggs themselves. So in fertilization he sees a three-body reaction where the substance borne by the sperm corresponds to

the antigen, the fertilizer to the amboceptor and a substance contained in the egg corresponds to the complement. This conception satisfactorily fits many points in the experimental data, but much work still remains to be done to thoroughly elucidate the phenomena.

W. H. F. A.

VENEREAL DISEASES. By C. H. BROWNING, M.D., of the Bland-Sutton Institute of Pathology, and DAVID WATSON, M.D., of Glasgow University. Pp. 336; 75 illustrations (26 in colors). London: Oxford University Press, 1919.

THIS admirable little book is introduced by Bland-Sutton, who sounds its keynote, when summarizing, in the most concise way the wonderful progress made in the last quarter century in our knowledge and control of syphilis, and showing that "with every improvement in the methods of investigating disease, knowledge of syphilis has advanced," while "its fell companion, gonorrhea," is likewise equally deserving of the intimate study here given for the tragic role it plays in life's drama.

The book is really a double treatise, the first half being devoted to syphilis and an equal amount to the subject of gonorrhea. It is written throughout in delightful style and carries the reader forward with ease and interest by its simple diction and clearness of presentation. It is hardly necessary to itemize the chapters of the book and their contents; suffice it to say that it is wonderfully thorough and complete in every detail and served by an accurate index. One finds under syphilis not only the clinical manifestations, but valuable and detailed laboratory procedures; under treatment not only drugs and their administration, but interpretations of the stages of the disease and the varying significance of the Wassermann test and how its bearing should be interpreted on future treatment and marriage.

The second portion, devoted to the subject of gonorrhea, is equally thorough in its exposition and in every way up to date. Certain lessons born of war experience in the control of venereal disease, prophylaxis and treatment are entirely new to the literature of the subject. There is really very little the reviewer finds to take exception to in the book: the prophylaxis recommended differs slightly from that practised in the American Army, in that permanganate of potash (1 to 1000), acriflavin (1 to 4000) or silver nitrate (1 per cent.) is recommended in place of the organic silver salts; the condemnation of making a dorsal slit in acute phimosis; the lack of appreciating the advantages of epididymotomy in acute gonorrheal infection (and the rather broad statement that it always causes sterility); the fact that mention is not made of examining the prostatic secretion in the fresh smear; and the poor character

of a few of the illustrations, especially when compared to the excellent quality of the majority, may, however, be mentioned. Three appendices on laboratory methods is an added value.

The work throughout is indicative of men intimately familiar with their subject, and versed in the most modern diagnostic methods and treatments.

A. R.

LECTURES ON SEX AND HEREDITY. By F. O. BOWER, J. GRAHAM KERR and W. E. AGAR. Pp. 119; 49 illustrations. London: Macmillan & Co., 1919.

THIS little volume embraces four lectures on the biological problems connected with reproduction in plants and animals and two lectures dealing with the subject of heredity. These lectures were obviously written for the lay audience and contain very little that is not already known to the medical profession. The chapters on heredity are well written and present, in a very clear manner, the major factors concerned in this interesting subject, including Mendel's law. The book will be of value for elementary instruction in biology to academic students.

F. B. B.

THE OXFORD MEDICINE LOOSE-LEAF ADVANCE PAGES. Edited by HENRY A. CHRISTIAN and SIR JAMES MACKENZIE, Oxford University Press. Pp. 109 to 341. New York: American Branch, 1919.

THE advanced pages of Parts II and III of Volume I have just reached the subscribers to the Oxford Loose Leaf Medicine. Part II contains a splendid treatise on pathological physiology and its relation to internal medicine, by A. Walter Hewlett. This chapter is an excellent exposition of the subject-matter and bears rereading. Guy Hinsdale discusses hydrotherapy in Chapter IV. Just enough detail is given to make it practical and very entertaining at the same time.

Undoubtedly the best chapter is devoted to the treatment of disease by Sir William Osler. These lines are written in his usually masterful style and are well worth while. It is, as it were, an epitome of the experience of the therapeutic life of this remarkable teacher and doctor. The causes of disease and how they act is well discussed by James Mackenzie. Disease production by all living organisms forms an interesting portion of this chapter. Eugenics in relation to medicine, by Charles B. Davenport, is assigned to Chapter VII. Here the question of heredity receives ample treat-

ment while paragraphs devoted to applied eugenics are worthy of mention. Billings discusses his favorite subject, focal infection, in the last chapter of Part III. Nothing especially new is dealt with, but an old topic is well taken care of by this well-known authority on the subject.

These two parts of Volume I, as the foregoing description indicates, deal with the usual topics taken up in the first volume of a series on medicine. Viewed as a group they are meritorious from any standpoint whatsoever, whether that be up to date, literary or honest scientific value. The loose-leaf idea is an excellent one and the list of contributors for this system includes the best-known names in medicine both in this country and in England. These points should make it a popular system. T. G. S.

THE CANADIAN MEDICAL WEEK. Published under the Auspices of the Ontario Medical Association. Toronto: The Macmillan Company of Canada, Ltd., 1919.

"EVERY person into whose hands this book comes is a patriot. Many of us are not in khaki; the reason that keeps us comfortably in Canada while our country calls are various. Although the reasons of each satisfy his own conscience, they do not excuse him from devoted patriotic effort at home. It is our duty to study our own problems. Be prepared to carry on!"

The Ontario Medical Association has put in permanent form the records of the meeting of the Association which was held in Hamilton, May, 1918. The volume starts with a tribute to those members of the Canadian Universities who paid the "supreme sacrifice" on active service in the present war, and then is followed by the impressive beautiful "Flanders' Fields," by the late Dr. John McCrae. The papers that were presented to the various sections make up the great bulk of the text. Articles in various phases of eye, ear, nose and throat, medical, obstetrical, gynecological and pediatrics, follow, as well as other branches of medicine. The papers are, for the most part, well prepared and well deserve perpetuation in such a volume as the one at hand. J. H. M., Jr.

THE INTERNATIONAL MEDICAL ANNUAL. A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX. Pp. 517. New York: William Wood & Co., 1919.

THE first *International Annual* was published thirty-seven years ago and this 1919 volume, in review, is in every way as comprehensive and as useful as any of the other years. It aims, of course, merely to review the new thoughts concerning diseases and injuries

that have been brought forth during the past year and it very effectively accomplished this purpose. Naturally in this volume considerable space is given to post-war problems. Dr. Hey Groves's and Dr. C. A. Joll's articles on orthopedic surgery and orthopedic appliances are very comprehensive, and Sir Robert Jones's article on manipulative treatment of injuries to joints points out principles that have been accorded general recognition. Fractures and gunshot wounds, surgery of the nerves, surgical shock, neurosis of war, surgery of the abdomen and face are all fully reviewed.

Dr. Carey Comb's article deals with the soldier's heart and lays stress on work carried out under adequate observation as an important factor in bringing about a cure. The recent literature on cerebral fever and influenza is fully considered by Dr. Rolleston. Dr. S. A. Kinnier Wilson writes on encephalitis epidemic. In an instructive article by Dr. C. S. Bacon on the vomiting of pregnancy it is mentioned that alcohol is very valuable, but he cautions against giving it too strong or in too large a quantity. In Dr. Latham's article on pneumonia mention is made of treatment with quinin urea hydrochloride.

Skin diseases and eye diseases are very well covered. Of special interest are Dr. Foster's studies on trachoma. Excellent illustrations accompanying his article on diseases of children receive their just consideration, and very good reviews appear on infant-feeding, marasmus, ileocolitis, diarrhea, tetany, vulvovaginitis, rickets and infectious diseases. Dr. John Comrie gives some excellent diet tables in his article on diabetes, and mention is made of the many contradictory reports as to the value of sodium bicarbonate in the treatment of this disease. Syphilis and gonorrhea are considered, and an interesting page appears on the efforts of soldiers to counterfeit these diseases to secure admission to the war hospitals.

An interesting criticism of the metric system appears in the introduction, and sympathy is expressed for our continental colleagues who are compelled to use that system.

As usual the dictionary of remedies appears, which gives new uses for old remedies and a description of many new remedies.

A very complete index makes reference easy. The volume will prove very useful, indeed, especially to those who have not the time nor the facilities to keep up to date with current medical literature.

C. N. S.

SURGICAL CLINICS OF CHICAGO. Volume III, No. IV. Pp. 287; 117 illustrations. Philadelphia: W. B. Saunders Company, August, 1919.

It has been the reviewer's good fortune to be called upon to report as a reviewer on the *Surgical Clinics* at various times. This last number is, in his opinion, the best turned out in several months.

The first article on peripheral nerve surgery is an extremely interesting and instructive one, coming at a most opportune time. The writer, Lewis, is admirably fitted for writing on the subject, after his experiences in war surgery in the A. E. F. C. P. Nesselrode's article on cranial osteoperiosteal grafts contributes many useful points in technic as well as symptomatology. E. W. Ryerson, in the report on his clinic, demonstrates very ingenious and satisfactory reconstructive methods of surgery on the acromioclavicular and elbow-joints. L. J. Pollock, on brachial plexus lesions, and F. A. Norris and R. S. Reich, on foreign bodies in the tissues contribute articles which complete the war-surgery portion of this number of the *Clinics*.

The remainder of the twenty articles are on civil surgery and are written by such men as A. D. Bevan, Ochsner, Eisendrath, Davis, Kellogg, Speed, Kretschmer and others.

An added feature of interest in the *Clinics* is the universal appearance at the conclusion of each case a report of the ultimate results obtained in the case. This certainly lends weight to the article preceding.

E. L. E.

STERILITY IN WOMEN. By ARTHUR E. GILES, M.D., B.Sc. (Lond.), M.B., Ch.B. (Vict.), F.R.C.S. (Edin.), M.R.C.P. (Lond.), Captain, R.A.M.C. (Temp.), Senior Surgeon to the Chelsea Hospital for Women; Gynecologist to the Prince of Wales's General Hospital, Tottenham. Pp. 196; 11 illustrations. London: Henry Frowde and Hodder & Stoughton, 1919.

WITH the loss of hundreds of thousands of potential fathers in the last few years and the consequent limitation of marriages it has become increasingly important that the marriages which are consummated should be fruitful. In this timely appearing book Giles has presented the causes of sterility in male and female and the measures to remedy the conditions.

The first chapter deals with man's share of the responsibility for childless marriages and includes various detailed tests for determining his procreative ability. The second chapter is a collection of statistical tables and surveys. Following this the bulk of the book takes up the various classifications, types and causes of sterility. Functional, primary, congenital and acquired and secondary sterility are discussed. The author adds to the well-known one-child sterility a section on two-child sterility. The chapter on diagnosis gives an outline well adapted to systematic use. The chapter on treatment is a well-balanced discussion of the various measures which have been found useful. The general bibliography, ten pages in length, dates back to 1609. The book will merit attention from those interested in the subject.

P. F. W.

ATLAS OF OPERATIVE GYNECOLOGY. By BARTON COOKE HIRST, M.D., Professor of Obstetrics, University of Pennsylvania. Pp. 292; 164 plates, 46 figures. Philadelphia and London: J. B. Lippincott Company, 1919.

As the title implies, this book is devoted to the graphic method of describing operations for conditions peculiar to women and in the preparation of the atlas conditions common to both sexes have been purposely omitted. The volume is profusely illustrated with actual photographs as well as drawings from life. In the beginning of the book the author describes in detail his clinic, preoperative preparation, instruments and postoperative care of patients as carried out at the maternity department of the hospital of the University of Pennsylvania. The bulk of the book is devoted to the description of various operative procedures, the text being more or less supplementary to the illustrations. As has been his custom for many years, the author recommends the intermediate repair in perineal lacerations and describes an operation that he has devised and which he terms a "rational perineorrhaphy." The technic of salpingectomy which the author recommends can hardly be accepted with approval, as there is an utter disregard of the ovarian blood supply, and recent investigators have shown this point to be the most important one in the technic. The author's extensive experience with the various methods of performing Cesarean section makes the chapter of the book devoted to this topic a most valuable one, while the chapter on operations upon the mammary gland, which concludes the book, is concise and fits in well with the preceding chapters. To those who have had the pleasure of reading the author's previous publications this work will be a welcome addition.

F. B. B.

CLINICAL CASE-TAKING. By ROBERT D. KEITH, M.A., M.D. (Aberd.), formerly Principal of the King Edward VII Medical School, Singapore; Consulting Physician, Tan Tock Seng's Hospital, Singapore; Lecturer on Clinical Medicine in the King Edward VII Medical School. Pp. 104. New York: Paul B. Hoeber, 1919.

THE little book in hand is written as an elementary guide to students who are just starting the study of clinical medicine. It first deals with the general examination of the patient, including the history. Physical examination and the various systems of the body then follow. The concluding chapter is on laboratory examinations. The book is extremely brief and is limited to the outstanding features of the several conditions that are discussed by the author.

J. H. M., JR.

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SURGERY

UNDER THE CHARGE OF

T. TURNER THOMAS, M.D.,

ASSOCIATE PROFESSOR OF APPLIED ANATOMY AND ASSOCIATE IN SURGERY IN THE
UNIVERSITY OF PENNSYLVANIA; SURGEON TO THE PHILADELPHIA GENERAL,
ST. AGNES AND NORTHEASTERN HOSPITALS.

Some Points about Bone Grafts.—WHEELER (*British Med. Jour.*, February 1, 1919, p. 119) from a study of thirty war cases says: Whatever the histological role, the clinical usefulness of a bone graft is not affected. The final success of bone grafting in cases in which a gap is bridged depends upon the operation of Wolff's law, *i. e.*, the graft, stimulated by strains and stresses changes its internal architecture and external formation until the required strength is attained. In other words "the amount of growth in a bone depends on the need of it." (Murphy). The periosteum should be left on a graft, because, although not essential, it is the medium through which new bloodvessels enter the graft and the surrounding structures. Furthermore, in removing the periosteum superficial layers of osteoblast may be sacrificed. A periosteum-covered graft is less likely to become rapidly absorbed. To provide the strains and stresses it is advisable to allow the graft to functionate as early as possible, but in most cases preliminary fixation for three months is necessary. In old ununited fractures with false joints the bone in the critical area (near the site of fracture) is sclerosed and avascular; and makes an unsuitable soil for that portion of the graft in contact with this area. Growth in the graft is impeded by the surrounding sclerosis. Dense sclerotic bone has no osteogenetic power. In such cases a periosteum-covered graft, instead of exhibiting osteogenetic powers and responding to Wolff's law, may become attenuated and absorbed or break in the critical area five or six months after operation. In the same class of cases very prolonged fixation is particularly unfavorable to osteogenesis, to the establishment of blood supply and bony union. Early movements and the bearing of mechanical stress and strain, on the other hand, may lead to yielding of the graft and failure. The problem is a difficult one in the case of the humerus or femur, where strength is essential from the commencement of treatment, but may be solved by wide resection of the sclerosed

bone, and resignation on the part of the patient to a short limb. But for slightly slower osteogenetic powers, and a real tendency to fracture, the intramedullary peg is effective. This method of bone grafting is satisfactory in the case of the radius and ulna. In the case of the humerus and femur, long stout inlay grafts give the best results. Sliding grafts should be employed only in simple and fresh cases. The bone graft has inherent bacteria-resisting properties. Absolute fixation of the graft in its bed, either as part of the operation, or afterward by splints or plaster, is essential to success. Bone grafting for spinal caries is followed by more uniformly successful results than is seen elsewhere. This is to be expected, since both the graft and the recipient bed (in the region of the spinous processes) consist of healthy bone. As in the operation of tendon transplantation and nerve suture, the operation of bone grafting should be preceded by correction of any existing deformity and by the freeing of adhesions in neighboring tendons and joints.

Total Enucleation of the Prostate.—FREYER (*British Med. Jour.*, February 1, 1919, p. 121) says that in 1912 he reviewed 1000 cases in which he had performed his operation of prostatectomy and that now he wishes to add a further series of 550 cases. He emphasizes particularly the employment of the operation in advanced old age and in those conditions in which it is desirable to divide the operation into two stages—namely, (1) a preliminary suprapubic cystotomy for drainage of the bladder, and (2) enucleation of the prostate at a subsequent date. He recognizes three definite conditions in which it is advisable to drain the bladder before removing the prostate. (1) When the bladder is very septic, generally complicated by the presence of phosphatic calculi, and particularly when there is reason to believe that the kidneys are secondarily affected, as indicated by recurrent attacks of rigors and pyrexia with emaciation and debility of the patient. (2) When, no catheter having been previously used, the patient has intensely frequent but painless micturition with dribbling the result of an over-distended bladder. He is developing symptoms indicative of incipient uremia and the disease is advancing insidiously. He has one or two ounces of residual urine. The bladder should be slowly drained by the use of a retained catheter of narrow calibre and a suprapubic cystotomy performed in a few days, the enucleation of the prostate being deferred for a fortnight longer, until the kidneys have regained their normal functions and all the uremic symptoms have disappeared. A large retained catheter may produce sufficient drainage without the cystotomy. Freyer does not favor the division of the operation into two stages except when absolutely necessary. He did the two-stage operation only 72 times out of a total of 1550 operations. Apart from the extra period the patient must stay in bed, it is much more difficult to enucleate the prostate when deferred for ten days or longer after the cystotomy, for the tissues around the suprapubic wound will have become tense and rigid from the plastic lymph thrown out, with the result that the abdominal wall will not be soft and yielding to the hand, the finger of which is in the bladder for the enucleation and there will be difficulty in reaching the distal aspects of the prostate.

Pneumonias Following Injections of Arsenobenzol.—SCHWERDT-FEGER and TINKER (*Am. Jour. Syph.*, 1919, iii, 398) say that the ordinary reactions following intravenous injections of the various preparations of arsenic in the treatment of syphilis are well known. Intravenous injections of arsenobenzol were given to nine syphilitic soldiers on November 23, 1918, at the U. S. General Hospital No. 26, Fort Des Moines, Iowa. All had symptoms immediately after the injection, or within a few minutes, of irritation to the respiratory tract and within a few days developed bronchopneumonias. They were critically ill, but made complete recoveries. The writers describe the clinical features of the reactions, the preparation of the solutions, the technic of its injection, and then attempt to determine the cause of the reactions. Extreme dyspnea was the outstanding feature in the clinical picture. By the exclusion of all other possible causes it was concluded that the drug was responsible for the reactions. In a succeeding paper by Jay Frank Schamberg presented as "Comment" on the paper of Schwerdtfeger and Tinker it is stated that "the fault lay with the operator, for the instructions accompanying the ampoules state distinctly a concentration of 0.6 grams in 100 to 120 c.c. of water, instead of which nearly 0.5 grams were given in less than one-fifth of this volume."

Choice of Methods in Operations upon the Pituitary Body.—FRAZIER (*Surg., Gynec. and Obst.*, 1919, xxix, 9) says that the life history of the pituitary tumor is a matter of no small significance. In its pathological deviations the pituitary is not unlike the thyroid gland. As with the thyroid so with the pituitary the most common lesion is the adenoma, in both instances often with cystic developments. It is within the limits of a reasonable estimate to say that 75 per cent. of pituitary tumors may be classified as adenomata. In fact the more minutely specimens are examined and the greater the experience of the examiner, the smaller the percentage of malignant growths. While pituitary lesions at best present many grave aspects, the absolute benignity of the underlying process in the majority of instances detracts somewhat from an otherwise serious situation. In other words if means can be devised to prevent the recurrence of local or general intracranial pressure, the life and comfort of the patient may be assured for many years. As a result of the larger and longer experience in dealing with pituitary disorders he has been able to formulate with greater precision the conditions under which surgical therapy is indicated. The symptoms of pituitary disorders which must be reckoned with are: (1) those due to general intracranial pressure, such as headache; (2) those due to involvement of the optic chiasm and tract—the ocular phenomena; (3) those due to involvement of the neighboring structures; and (4) those due to secretory derangement. As yet Frazier has had no cases under his care where justification for the risks entailed in operation were furnished by the secretory disorders, such as acromegaly or the Froelich syndrome, or by neighborhood symptoms, so that in large measure the surgeon is asked to intervene for one of two conditions, either distressing headache or vomiting or failing vision which, in the mind of the patient, provides the imperative demand for relief. Unfortunately, in the majority of patients who have consulted him the optic atrophy is already so far

advanced that restoration of vision is out of the question. In the constructive period of any field of surgery, the pendulum of opinion swings from one view to another. Frazier's first introduction to pituitary surgery was through the frontal route. Later a number of his cases were operated upon by the transnasal route, but its limitations soon became apparent and he returned with certain revisions to his original fronto-orbital technic. The surgeon dealing with pituitary lesions should be familiar with both methods, but as time goes on he believes the fronto-orbital route will be found to have a wider field of application.

A Study of Bladder Function.—CURTIS (*Surg., Gynec. and Obst.*, 1919, xxix, 24) says that whether he shall leave an ill-functioning bladder to right itself or shall assist nature through the use of a catheter, is a problem of much importance; it concerns not only the bladder of the soldier with spinal injury, but also many other conditions, notable among which is stasis of urine after operation. Failure to catheterize the paralyzed bladder is followed (in rabbits at least) by back pressure of urine which is exceedingly destructive to kidney tissue. Associated urinary infection is frequent. Irregularly performed catheterization for retention of urine is unsatisfactory. Patients so treated are subjected to such dangers as accompany the passage of the catheter and at the same time are rendered liable to accumulations of infected stagnant urine. Carefully managed catheterization, of the bladder which fails to empty spontaneously, yields excellent results; the catheter should be regularly passed often enough to prevent vesical distention and its use must be persisted in until daily tests show that residual urine is no longer being retained in the bladder.

Gunshot Fracture of the Femur.—BUCHBINDER (*Surg., Gynec. and Obst.*, 1919, xxix, 70) says that fracture of the femur ranks first in so far as difficulty in treatment is concerned. Because of the relatively large size of the thigh, it is impossible, except by open operation, to obtain and maintain reduction with the same ease and accuracy as can be secured in fractures of the smaller extremities. More frequently than in any other type of fracture, the end-results in their cases have been accompanied by some degree of permanent disability. No septic wound is more difficult to control than a deep intermuscular phlegmon of the thigh, particularly when caused by high explosive shell or fragments. Buchbinder devoted his study to the details of treatment of this type of fracture and to the exposition of a simple and highly efficient method of standardizing this treatment: He says that immediate and continuous immobilization lessen the likelihood of sepsis. The caliper modification of the nail extension is a particularly valuable method of reduction, because: It is far more dependable in its extension and with less weight than a Buck's extension. It permits complete exposure and opportunity for inspection of the thigh at all times. It permits as does no other method, early and continuous mobilization of the knee-joint. It is more comfortable to the patient.

THERAPEUTICS

UNDER THE CHARGE OF

SAMUEL W. LAMBERT, M.D.,
NEW YORK,

AND

CHARLES C. LIEB, M.D.,

ASSISTANT PROFESSOR OF PHARMACOLOGY, COLUMBIA UNIVERSITY.

The Administration of Arsphenamin. — HYMAN (*Boston Med. and Surg. Jour.*, 1919, clxxx, 353) describes the technic of administering arsphenamine and advocates a standard method of administering the remedy. There is no question of the value of having a standardized method of administering such a widely used remedy but the diversity of opinion of clinicians and investigators of this drug has to this time prevented the solution of the problem. McCoy of the Public Health Service has recently issued a circular with such a purpose in view but his views have not been accepted by a number of clinicians. The author of this article is of the opinion that McCoy's statements have been too emphatic to meet with unanimous approval. The administration of arsphenamine is frequently attended by more or less severe reactions and the avoidance of these reactions is the ideal to be attained by proper administration. In Hyman's series of 500 doses, reactions occurred in 58 instances or 11.6 per cent. The reactions have occurred with diminishing frequency, which he believes due to the application of principles developed from an intensive study of the reactions occurring in the first 100 doses. Hyman considers the reactions that follow the administration in four general groups. The first group shows an immediate reaction to the intravenous injection of the solution, indicated by an increasing congestion of the bloodvessels of the face and neck. The patient becomes cyanotic and dyspneic and seems critically ill. This reaction is believed to be due for the most part to an increase in the fluid content in the circulating system and can be avoided by bleeding before the injection of arsphenamine. Certain vasodilator drugs have also seemed to prevent the development of these symptoms. The second type of reaction, the most common, develops within the first twenty-four hours, usually within a period of from three to eight hours after the injection. Nausea, vomiting, hyperpyrexia, headache, vertigo, severe abdominal pains, diarrhea, or general pains throughout the bones are the chief symptoms. This reaction, according to Hyman, is essentially a manifestation of alkalosis and can be successfully treated on this basis. The fact that it is impossible to calculate with any accuracy the amount of alkali required to neutralize a given solution of dissolved arsphenamine and to redissolve the precipitate is well known. The tendency is almost universal to add an excess of alkali. Therefore such reactions can be avoided by more care in the preparation of the solution. It is stated in addition that the administration of acids will relieve the condition. Hyman mentions the juice of citrus fruits, vinegar salads, pickles,

sodium acid phosphate, as the proper remedies. The third type of reaction is not common, and may be described as a subacute or delayed arsenic poisoning with its well-known clinical picture. The fourth type of reaction, the so-called Horkheimer reaction, was only observed once in the author's series. Nothing relative to the prophylaxis and treatment of the reactions falling in the third and fourth group was learned in this series. Hyman believes that these disagreeable complications may be entirely eliminated or greatly reduced by observing the precautions noted in his article. The author recommends the administration of arsphenamine by gravity together with physiological salt solution.

Reactions Following the Administration of Arsphenamine.—HYMAN (*Jour. Am. Med. Assn.*, 1919, lxxiii, 901) reports on reactions following the administration of arsphenamine in a series of 25,000 injections. He states that reactions have their origin in drug toxicity, technical errors, or in causes relative to the patient himself. There is a wide variation of opinion as to a correct technic by equally eminent authorities, but certain essentials have been established as the result of clinical experience and animal experimentation. The use of dilute solutions in freshly distilled water and slowness of administration are generally accepted. Proper neutralization is an important factor. In Guy's experience the arsenobenzol brand of arsphenamine has made a better record than salvarsan; though later this difference was but very little. He believes that arsphenamine is a comparatively safe product and that errors in preparation and in technic of administration produce the majority of the reactions. However, even with the best of technic, and with a drug that is comparatively non-toxic, reactions will be encountered that have their origin in the patient himself. These are the most difficult to avoid and great care must be used as regards the amounts of the remedy administered to patients with impairment of renal, hepatic, pulmonary, digestive, etc., functions. The status of the syphilitic infection itself has something to do with the incidence of reactions. Febrile reactions have been noted most frequently in the florid secondary stage of the disease. Guy thinks it reasonable to believe that some reactions are due, at least in part, to the destruction of enormous numbers of spirochetes, liberating the protein of their bodies into the blood stream with the production of an anaphylactic type reaction. Guy gives the details of the technic of administration, for which the original article should be consulted.

The Administration of Arsphenamine.—McCoy, in a note (*New York Med. Jour.*, 1919, cix, 879) on the administration of arsphenamine, says that when the numerous complaints received by the U. S. Public Health Service regarding arsphenamine are investigated, it is almost invariably found that the drug has been used in a solution that is too concentrated and that it has been administered too rapidly—as much as 0.4 gm. in a volume as little as 25 c.c. having been injected within thirty seconds. Such practice is abuse, not use, of a powerful therapeutic agent. He recommends that, in addition to the usual precautions, physicians give the drug in concentrations of not more than 0.1 gm. to 30 c.c. of fluid and allow a minimum of two minutes for the intravenous injection of each 0.1 gm. of drug. This would

necessitate from 90 c.c. to 180 c.c. of solution for the doses usually given and would require from six to twelve minutes for the injection. In this way, McCoy believes, the number of reactions would be very materially reduced.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,
OF PHILADELPHIA.

Certain Malnutritional Disorders of Children Associated with a Putrefactive Intestinal Flora.—PORTER, MORRIS and MEYER (*Am. Jour. Dis. Children*, October, 1919) report the results of their study to establish the fact that there is an etiologic relationship between protein-splitting bacteria and certain types of alimentary intoxications that occur during the earlier years of life. The types of intoxication studied were: A mild type constipation, lack of gain, pallor, head sweating and loss of turgor, the so-called balance disturbance of the Finkelstein school; a fulminant acute type with sudden onset, profound cumulative toxemia, tremendous shock, alarming loss of weight and too often an early fatal issue with acidosis; a grave chronic type with diarrhea which occurs for the most part between the tenth and twentieth months, characterized by frequent stools, anorexia, progressive loss of weight and increasing toxemia, and which earlier classed as "Coeliac disease, pancreatic insufficiency, chronic alimentary intoxication;" certain sporadic, acute, putrid diarrheas of young infants; a type of chronic malnutrition to be found in older children, which in its clinical features corresponds to the balance disturbance of infants, but in which the symptoms are modified by the difference in the ages and dietetic habits of the patients. From their studies the authors found that children whose diet was well balanced and whose nutrition was normal, have an intestinal flora consisting of fermentative and putrefactive types without a preponderance of either; that children fed on large quantities of cow's milk have a more complex flora, made up of various types, most of which are facultative putrefactors; that in children who suffer from certain types of alimentary intoxication with malnutrition, the intestinal flora departs in a uniform manner from the normal, and that this departure is always characterized by the establishment of bacterial types predominatingly putrefactive; that the return of these children to normal health is coincident with a regression of the intestinal flora toward a predominatingly fermentative type, and a later swing to a balance between these types; that such changes in the intestinal flora can be brought about in the intestine of the human infant by withdrawing animal protein, and persistently feeding large amounts of lactose (from 2 to 4 ounces daily), and other carbohydrates; that the period which may be necessary to produce this variation is from ten to forty days; that feeding acidophilic cultures has in a few cases aided

in a more rapid establishment of aciduric flora in the baby's intestine, this influence was not very great; that the progressive cessation of the symptoms of intoxication, and a return of toxemic patients to a nutritional health coincides with the recognizable dominance of a fermentative flora; that lactose and dextrin are the carbohydrates most effective in encouraging the rapid establishment of a fermentative flora in the intestines of infants and children.

The Insusceptibility of Man to Inoculation with Blood from Measles Patients.—SELLARDS (*Bull. Johns Hopkins Hosp.*, September, 1919) says that he made an effort to determine whether the virus of measles exists in the circulating blood of a patient, permitting the transfer of the disease from person to person by the inoculation of blood. Two cases were reported previously by Hektoen in which the disease was successfully transmitted by inoculation. The author failed to transmit the disease in 8 cases. The clinical phenomenon of the origin of the rash on the face or the upper part of the body with its gradual progress downward requiring from one to three days to complete this march, is interesting. The symptoms of the two experimental cases that have been reported were not entirely characteristic of the classical type of measles. Although the disease varies extremely little in its clinical manifestations distinct modifications might readily occur under experimental conditions. As regards the negative results in the 8 cases of the author, the principle difficulty arises in establishing, by the clinical history, the susceptibility of an adult to a disease so generally prevalent as measles. In some of the men who were inoculated the circumstantial evidence of susceptibility was very strong. Failure to transmit the disease by the injection of blood does not preclude the existence of the virus in the blood stream even in moderate amounts. There was some evidence that these individuals not only failed to become infected, but that they were actively immunized by the injection of the blood. This would presuppose the existence of the virus in the blood. The agent which excites the rash might readily gain access to the blood stream regardless of whether its distribution takes place by the lymphatics or by the circulating blood. The constant origin of the eruption on the upper part of the body and its gradual and orderly extension downward is quite unlike the development of eruptions in which the virus is known to be distributed by the circulating blood.

Study of the Stools in Children's Institutions Showing the Incidence of Intestinal Parasite Infections.—DEBUYS and DWYER (*Am. Jour. Dis. Children*, October, 1919) found in their study of 595 individuals in seven institutions that the frequency of infection by the various parasites was in the following order: *Trichuris trichiuria*, *Ascaris lumbricoides*, *Hymenolepis nana*, *Oxyuris vermicularis*, *Necatur americanus*, and *Hymenolepis diminuta*. The hygiene, general care, duration of residence in the institution, previous environment, association with dogs, eating of dirt, absence of systematic medical inspection, seemed to have a direct bearing on the frequency of intestinal parasitic infection. The two institutions where systematic medical inspections were made, even though there were many crawlers in one of these institutions, showed the lowest percentage of infections, namely, 17.89

per cent. and 19 per cent. respectively. The two institutions where the heaviest infections were found, were those where the population was transient, and where there were no medical inspections, the infections being 90.2 and 83.33 per cent. respectively. The youngest individual infected was in the least sanitary of the institutions investigated. This child was two years of age and had a quadruple infection of *Trichuris trichiuria*, *Ascaris lumbricoides*, *Oxyuris vermicularis*, and *Strongyloides stercoralis*. The relation of age to infection seemed negligible except that there was no infection among infants. The maximum number of infections occurred at the age of eleven years. Males were infected over 13 per cent. more frequently than were females. The element of exposures seems to have had some influence. The maximum ages of infection in boys were eleven and twelve years and for girls thirteen years. No information of value was obtained in studying the incidence at the different ages except that the greatest incidence in boys was fourteen infections in twenty boys, or 70 per cent. of infections at the age of twelve years, and for the girls fifteen in twenty-one or 71.5 per cent. of infections at the age of eight years. The symptoms usually attributed to "having worms" were as frequent, and some more frequent in those not having parasites. One infection with the rat tapeworm (*Hymenolepis diminuta*) was found in a female child three years of age. The infection occurred in association with *Trichuris trichiuria* and *Ascaris lumbricoides*. An eosinophilia was found to be a valuable aid in the diagnosis of infection with intestinal parasites. It is not pathognomonic and its absence does not exclude an infection. The eosinophils were found as high as 28 per cent. in the positive cases and 18 per cent. in the negative cases. They were 4 per cent. or above in 59.5 per cent. of the positive cases and 4 per cent. or above in 32 per cent. of the negative cases. It was of interest that all of the eosinophilias of 15 per cent. and above in the positive cases occurred in the same institution. No parasite seemed to have a definite eosinophilia. It was shown that infections by any of the intestinal parasites could exist with an absence of eosinophilia. This was found in all infections with the exception of *Necator americanus* and *Hymenolepis diminuta*. The first was found in single infection in only 2 cases, in which instances the eosinophils were 12 and 13 per cent. respectively. In mixed infection with *Trichuris trichiuria* and *Hymenolepis nana* the eosinophils were as low as 1 per cent. The other exception was the *Hymenolepis diminuta*, which was not found in single infection, but in combination with *Trichuris trichiuria* and *Ascaris lumbricoides*, in which cases the eosinophils were 13 per cent. Minimum eosinophile counts in double and triple infections were zero, while the maximum was 28 per cent. in each. The two quadruple infection in which blood examinations were made showed an 8 and 9 per cent. eosinophilia respectively. The diagnosis of intestinal parasitic infection is very easy. The symptoms usually ascribed to worms are as frequent in those not infected as in those infected. Blood examination showing eosinophilia are valuable diagnostic aids, but the only method of making a positive diagnosis is by finding either the parasite or the ova in the stool. Vermifuges should not be given to the defenseless child unless it is known that an infection exists and its character is ascertained so that the specific drug may be given.

Organotherapy in Certain Diseases of Childhood.—McCREADY (*Med. Record*, September 27, 1919) says that the endocrine glands control metabolism and preside over growth and development in infancy and childhood; they are essential to mental, physical and reproductive efficiency in adult life, and they maintain catabolic balance in the period of decline. Many diseases and conditions of childhood are manifestations of organic inferiority in the etiology of which dysfunction of the endocrine glands is a more or less prominent and contributing factor. Treatment directed toward the stimulation, modification, and correlation of the action of the endocrine glands is a promising field for therapeutic endeavor. Treatment by organotherapy should be preceded by a careful analysis and consideration of the symptoms of the endocrinous dysfunction. He found that the usual doses of organic preparations especially thyroid are too large, are administered without due cause, often in unsuitable cases and tend to discredit a valuable therapeutic measure.

Congenital Syphilis.—DEBUYS and LOEBER examined 106 infants and children in a foundling institution both by the Wassermann and luetin tests. That these were accurately performed was proved by controls. Negative Wassermans were explained by the intensity of the treatment to which each child had been subjected, or because the bloods had not yet become positive. The luetin test in this series proved of greater value than the Wassermann reaction in detecting cases of congenital syphilis, and the clinical findings were of the greatest value at that time when the value of the luetin was at its minimum during the first few weeks. Because of the ages of those examined and the character of the institution, this investigation afforded an excellent opportunity to study the various available means of detecting the existence of congenital syphilis. Seventy-four and six-tenths per cent. were infants up to the age of two years, of whom 41.6 per cent. were under one year of age. Congenital syphilis was found to be relatively more frequent in the illegitimate than in the legitimate children. This study points out that skin eruptions of syphilitic origin may exist with the Wassermann and luetin reactions both negative. This emphasizes the necessity of exhausting every means of diagnosis especially the laboratory methods and complete physical examination. The skin reactions were more frequent in the younger subjects, twelve of the twenty-two instances being found in the first three months of life. Ten cases of positive syphilitic skin eruptions were detected at this time in which the luetin reaction had been negative. With very few exceptions all of the inmates of the institution were below the normal averages of weight, height, development and nutrition. Enlarged livers, spleens, and glands were the most constant clinical evidence of congenital syphilis. The incidence of congenital syphilis in this institution was 83.96 per cent. Seventy-nine cases, or 74.53 per cent., were shown by means of the luetin, and 10 cases, or 9.43 per cent., were shown by the clinical findings, revealing syphilitic skin eruptions. Many of the other cases classified as doubtful or negative, had certain of the clinical symptoms of congenital syphilis but were not sufficient to warrant a positive diagnosis.

OBSTETRICS

UNDER THE CHARGE OF

EDWARD P. DAVIS, A.M., M.D.,

PROFESSOR OF OBSTETRICS IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

Pregnancy Complicated by Epidemic Influenza. — TITUS and JAMISON (*Jour. Am. Med. Assn.*, June 7, 1919) report their experience in 50 cases of pregnancy complicated by epidemic influenza. They believe that epidemic influenza and pneumonia have so much in common that the study of influenza will throw light on the treatment of the ordinary type of pneumonia. Pregnancy greatly increases the mortality from epidemic influenza. In 42 per cent. of these patients studied, abortion or premature labor developed. The mortality of epidemic influenza in pregnant women, in whom pregnancy was not interrupted, 48.2 per cent.; but, when pregnancy was interrupted, the mortality rose to 80.9 per cent. An interruption of pregnancy is caused by the destruction of oxygen in the blood and excessive accumulation of carbon dioxid in the blood and a degree of toxemia sufficient to cause the death of the fetus. In the early months of pregnancy, abortion will not usually develop as soon as the embryo dies. In the later months, pregnancy may be interrupted without the death of the embryo. The ill effect of abortion or labor in women suffering from epidemic influenza results from muscular exertion, increasing the excessive amount of carbon dioxid in the blood and straining a weakened heart; also from the sudden release of intra-abdominal pressure following the expulsion of the fetus, in advanced pregnancy, and the sudden reduction of blood-pressure by the hemorrhage occurring at labor; and also by the lessened resistance of the patient to the ordinary disturbance of labor. Treatment should be preventive, and pregnant women should be urged to avoid all possible exposure to influenza, pneumonia or common colds. In cases of infection, absolute rest, fresh air, stimulation, elimination, the avoidance of violent purging and quinine sedatives are required, and the prompt termination of labor or abortion will be indicated. In labor it may be necessary to use forceps promptly. Anesthesia is contra-indicated and not required, because patients are usually so toxic as to be indifferent to pain. Whether the delivery be instrumental or spontaneous, precaution should be taken against hemorrhage and the uterus should be packed if needed. Normal salt solution should be used, preferably under the skin, to avoid the overloading of the circulation, which might result from intravenous injection.

Abdominal Pregnancy Continuing Four Months after Uterine Perforation; Operation and Recovery. — BISHKOW (*Jour. Am. Med. Assn.*, June 7, 1919) reports the case of a multipara, whose husband died two weeks following the menstrual period. As menstruation did not return the following month, the patient went to a midwife, who introduced a soft rubber catheter into the uterine cavity, where it remained two days. One week later, this was repeated, and the patient bled for three days.

Two weeks after abortion, she entered Bellevue Hospital, New York, having abdominal cramps, with epigastric pressure, where she remained one week. She refused to have curetting done, and left the hospital. Some months after, she entered the Michael Reese Hospital, where she remained three days, under observation. She then left and went to work in a tailor shop. In both hospitals she denied abortion and gave misleading statements. For the next three months, at her menstrual periods, she had a dark, foul-smelling discharge for two or three days. About a month after her last period, while at work, she had sharp pain in the rectum, becoming dizzy and with great disturbance of the circulation. Upon examination, she complained of cramp and slight nausea, was slightly pale, but with normal pulse and temperature. There was no marked tenderness or rigidity in the abdomen. On vaginal examination, the cervix was firm, with lateral lacerations. No tenderness or bulging in the vaginal fornices could be detected; the uterus could not be made out. Upon examination, under ether, a probe introduced into the uterine cavity passed through the uterus for some distance, and a diagnosis for perforation of the uterus was established. At operation, there was abundant dark hemorrhage in the abdomen, and the fetus was found among the intestines, advanced about five months. The cord extended from the fetus to the uterus, the uterus was slightly enlarged, firm and, at the fundus, was a smooth necrotic mass the size of a small orange. There was a transverse tear at the junction of this mass with the fundus anterior, and protruding from this were the placenta and its membranes, the umbilical cord extending through this opening. The tubes and ovaries were normal. The body of the uterus was removed, the patient finally recovering. Upon examination, the uterine wall had perforated to the right of the median line at the fundus; the placenta extended over the margin of the perforation. Undoubtedly, the catheters introduced had caused the perforation, and the products of conception had been expelled through the perforation into the peritoneal cavity. Enough of the placenta to keep the fetus alive remained attached. The rest protruded through the perforation, partially filling the opening and controlling the hemorrhage, to some extent. This circumstance probably saved the woman from death by bleeding. A false sac composed of fibrin had formed around the fetus and the placenta. The rupture of this sac and the expulsion of the fetus into the peritoneal cavity had caused the acute symptoms. The fetus had undoubtedly lived four months in the peritoneal cavity. Two similar cases are recorded, one by Henrotin, in which perforation occurred at two months, and the operation was done a month and a half later. The fetus was extra-uterine, but the placenta was fully within the uterine cavity. Leopold reported a case in which rupture of the uterus took place in the fourth month, from a fall, and pregnancy continued to term in the peritoneal cavity. The perforation of the uterus in criminal abortion is not infrequent.

Pubiotomy.—JELLETT (*British Med. Jour.*, May 10, 1919) presented a paper on this subject, in the Section of Obstetrics, in the Royal Academy of Medicine, in Ireland. He believes that this operation is of decided value, and gave statistics of thirty-five (35) operations, with two maternal and five fetal deaths. One mother died from fatty

degeneration of the heart; the other from tuberculosis. One of the infants that died was a twin and one had hydrocephalous. He believes that the operation leaves the woman permanently in better condition, and cited two cases with the same degree of pelvic contraction. One had four Cesarean sections; the other had pubiotomy done at the first labor and afterward had three spontaneous labors and one terminated by forceps; all of the children surviving. He emphasized the fact that pubiotomy leaves the pelvis permanently enlarged. In 22 labors occurring subsequent to the labor in which pubiotomy was done, 11 children were born spontaneously, 6 by forceps and 2 by a second pubiotomy, 3 children were born dead, one death being due to placenta previa. He believes that pubiotomy is indicated in both the first and the second degree of pelvic contraction. Cesarean section is a means only of terminating labor, while pubiotomy leaves the pelvis permanently enlarged. He urges that pubiotomy should never be postponed willingly to the end of the second stage of labor, but should be carried out independently of pregnancy, in cases in which the pelvis is contracted. In the management of these cases after operation, every effort should be made to prevent bony union of the cut surfaces. The operation should not be attempted where the true conjugate was less than 7 cm. He urged that the prejudice which has existed against the operation should be laid aside. In discussion, doubt was expressed as to the permanent enlargement of the pelvis. It was also thought unwise to do the operation upon a patient not pregnant or in the early period of gestation. If it were to be done before labor, the operator should wait until the child was viable.

A Method of Delivering the Placenta.—BAER (*Jour. Am. Med. Assn.*, May 24, 1919) draws attention to conflicting methods of delivering the placenta. His own custom is as follows: After the usual period of waiting, averaging half an hour, and when the uterus is at the height of the contraction, he grasps the abdominal wall crosswise above the fundus and pulls the rectus muscles together, thus raking up all the slack. The woman is then urged to bear down. If there should be adherent membranes they are treated in the same fashion which may follow any other method of expression. The advantage claimed for this procedure is a total avoidance of handling or pressure on the uterus, which is considered of great practical importance.

Postmortem Cesarean Section Following Death from Influenza Pneumonia.—HEPPNER (*Jour. Am. Med. Assn.*, March 8, 1918) in 108 cases of influenza complicated by pregnancy found that but one was treated by Cesarean section. This was a patient, aged twenty-four years, in her third labor. She was admitted in a moribund condition, markedly cyanotic and profoundly toxic. She was said to have been sick for six days before admission to hospital. It was evident that she had a moderate bilateral basal bronchopneumonia. The fundus of the uterus was 3 cm. above the level of the umbilicus. The fetal heart was easily heard and not much increased in rate. As not a sound had been obtained after operation, it was determined to wait for the patient's natural disease, and then if possible to save the child. About two hours after admission the patient died, the fetal heart sounds were becoming

less audible and for the last fifteen minutes were so feeble that they could not be heard with a stethoscope. Section was performed at the moment of death as rapidly as possible. The child was toxic and feeble but rapidly began to breathe and cry. It was not quite at full term, weighing three pounds and fifteen ounces. The child lived for twenty-five days after its birth, dying of croupous pneumonia, with pleurisy. Microscopic section of the lungs showed many alveoli filled with fibrin and foci of round-cell infiltration and areas of necrosis. There was also pleurisy.

Pregnancy in a Case of Improved Sporadic Cretinism.—WELZ (*Am. Jour. Obst.*, May, 1919) reports the case of a patient, aged thirty-six years, concerning whom little early history could be obtained. The patient described a number of childhood's diseases which she had had and a few days ago contracted ivy poisoning. When twenty-three years old, and one year after marriage, the patient had a severe nervous breakdown and was in bed for three months, with great mental disturbance. When seen the patient's mental state was stunted, although fairly intelligent. The patient's weight had increased steadily since twelve years of age up to 189 pounds. The skin was dry, coarse in texture, yellowish-gray in color, the face puffy about the eyelids. The thyroid gland could not be palpated. The uterus indicated a pregnancy of thirty-six weeks, the pelvis was somewhat smaller than the average, but symmetrical and without great obstacle. The urine had been normal except for the low urea percentage. The case was evidently one of sporadic cretinism, complicated by generally contracted pelvis. Labor pains failed to secure the descent of the child and section was performed without accident. The mother was not able to nurse the child, but mother and child ultimately did well.

Abnormally Fat Breast Milk.—SLAWIK (*Deutsch. med. Wchnschr.* January 20, 1919) in the clinic at Prague has noted infants getting breast milk with too high fat percentage. Numerous tests in the clinic have shown that certain patients continuously produce milk much too fat or much below the normal proportion and the children suffer from this condition. When the milk is too fat vomiting occurs early and persists. This occurs immediately after feeding, although there is nothing to suggest spasm or overfeeding. These children lose their appetite for the breast milk, grow pale and drowsy, with flabby muscles. There may be obstinate constipation, or the stools may be thin and odorless, afterward becoming rancid and thicker.

Milk Secretion.—In the *Journal of the American Medical Association*, May 17, 1919 appears a review of this subject in which various theories are stated. Gowen of the Maine Experimental Station has found variations in the secretions of milk which cannot be reconciled with the cell disintegration hypothesis. The fat concentration of the milk was maintained throughout life, but the proportions of solids not fat, which include sugar, proteins and salts, declined somewhat. The butter fat increases in milk taken at evening, while the other solids did not share in this increase. This change in the ratio of fats and solids points to the cell destruction hypothesis. These inconsistencies point to a secretory hypothesis for milk production.

GYNECOLOGY

UNDER THE CHARGE OF

JOHN G. CLARK, M.D.,

PROFESSOR OF GYNECOLOGY IN THE UNIVERSITY OF PENNSYLVANIA, PHILADELPHIA.

AND

FRANK B. BLOCK, M.D.,

ASSISTANT INSTRUCTOR IN GYNECOLOGY, MEDICAL SCHOOL, UNIVERSITY
OF PENNSYLVANIA, PHILADELPHIA.

Radium Treatment of Uterine Cancer.—Having conducted nearly two years of work with only small quantities of radium at his disposal, BAILEY (*Am. Jour. Obst.*, 1919, lxxx, 300) has reached the conclusion that the problems confronting the man possessing the small amount of radium salt are essentially different from those presented to the holders of several grams. With the small amount, in order to produce any effect at a distance from the applicator, it is necessary to leave the radium in position for such a length of time that there is a local necrosis. This is a serious affair because of the proximity of the bladder, rectum and ureters. In treating malignant conditions the possessor of 100 or 200 milligrams of the salt would do well at the present time, at least, to confine himself to the palliative treatment of inoperable and recurrent cancer and to the preoperative treatment of operable cancer. From January, 1915 to May, 1919, a period of four and one-third years, Bailey treated 356 cases of carcinoma. Of this number there were 20 cases that did not complete the treatment or were lost following the treatment. Three of these died following the first application while 14 were given but one application and failed to return. Three had the full treatment but did not return. This leaves 336 cases upon which the statistics of his report are based. Of this number there were 190 cases termed primary, that is, in which no operative procedure had been undertaken, except perhaps in a few cases a mild cauterization or curettage; 106 cases were recurrent cancer after a hysterectomy. Twenty-nine cases were treated after a Percy cauterization or an operation of the Percy type. As a result of experience with such types of cases as above outlined, Bailey has come to certain definite conclusions regarding the indications for radium application. The most advanced cases frequently present a massive growth involving all of the pelvic organs, but with little or no ulceration in the vagina. This is especially true of the recurrences. In such cases an application of radium can hardly do more than cause some slight diminution in size, with possibly local sloughing, and the patient's condition cannot be said to have improved; in fact, it eventually becomes worse than before and considerably more painful from the contraction of the tissues and the pressure upon nerve endings. Another type of the very advanced cancer is the ulcerating type, usually primary, with a deep cervical crater having undermined edges, so that the rectum and the bladder are in immediate proximity or involved in the growth. Treatment will relieve or partially

relieve, for a time the sloughing and discharge, but will almost invariably produce a fistula in the bladder or rectum earlier than it would otherwise occur. Advanced cases where the parametrium is deeply involved in one or both sides, providing that they are primary so that the cervix offers a location for the radium that is approximately in the middle of the tumor, are not infrequently greatly benefited, even to the extent in two instances of being free from the signs of the disease for considerable periods. The most that can be expected is the healing or partial healing of the local lesion with consequent disappearance of bleeding and discharge and some retrogression in the size of the parametrial involvement. Not infrequently the further extension of the growth is behind the vaginal vault. The palliation is often so great that the patient gains in weight, has a good color and enjoys a longer lease of life in comparative comfort than did those patients who, prior to the use of radium, had only the benefits of curettage or cauterization. Usually within a year a relapse occurs and the case slowly progresses toward the end. The last months are apt to be very painful, due to the general fibrosis throughout the pelvis, but there is little or no discharge. It is amazing how long patients will live in a condition of this kind, and even though they develop rectal fistulae they remain clean by careful attention to the bowels. Experience shows that in this class, even though there is some question of the beginning involvement of the bladder wall, a complete and deep raying of the entire lower pelvis gives the woman the greatest prolongation of life. The *borderline case* by universal agreement most properly falls into the radium field. Here the lesion advances a short way into the parametrium on one or both sides, to an extent that is determined with difficulty, but the uterus is held somewhat by the indurated tissue; or the lesion of the cervix is not deep but overlaps to some extent upon the vaginal wall. In this class the most amazing results are accomplished by radium for it renders most of the cases operable and produces in nearly all the disappearance of cancer cells in the local lesion. There are in Bailey's series seven uteri that were removed following radiation in which the pathological picture upholds the latter statement, for in none was there found any cancer of the cervix. Of 17 cases that fell into this class in 1918 and were treated with radium alone, 5 died of cancer and 8 are in poor condition. There are 4 in this group that are in good condition and might have some prospects, although they cannot be said to be free of all clinical evidence of the trouble to date. In the operable cases, one of three procedures may be adopted: the uterus may be left *in situ* and massive radiation conducted through the parametrium, a simple hysterectomy may be done followed by radiation, or a radical operation may follow the complete or incomplete raying of the pelvis. The operable carcinoma of the body of the uterus is such an indeterminable thing from the standpoint of judging of its extent that treatment with radium alone is seldom justified. The flat cancer extending over most of the mucosa and involving the wall in certain areas can hardly be expected to resolve from the blind insertion of radium into the uterine cavity especially if the uterus is considerably enlarged. The prophylactic treatment following the removal of a tumor offers a field in which a great deal may be accomplished, provided the operator does not remove most of the

vagina, as this cavity gives the only practical entrance for the radium applicators. Early recurrent cancer following hysterectomy treated by massive doses and by cross-fire have resulted, in a number of cases, in complete retrogression and in numerous cases with a prolongation of the patient's life.

Value of Water in Nephrolithiasis.—In a very interesting article OCHSNER (*Jour. Am. Med. Assn.*, 1919, lxxiii, 1105) relates an unusual experience that he had in his early practise and points out the possibility of obtaining valuable suggestions from patients in certain cases. The patient in question was a manufacturer of steam boilers who had been a sufferer from recurrent renal colic. On asking him whether he had experienced any attacks recently, he stated that he was definitely through with renal colic, and suggested that if the doctors used their intelligence as actively in their profession as boiler manufacturers had to in their business, no one would ever have to experience a second attack unless he had more than one stone in his kidney to begin with. He stated that when his customers complained of their boilers filling up with lime in the form of scales, he advised them to use rainwater and this ended the trouble; so on the same principle he drank freely of distilled water, and had been free from a recurrence of kidney stone and renal colic. Ochsner immediately tried this treatment on a patient and in the twenty-nine years that followed, the patient never had another attack of colic, although he had been subject to them frequently before. He has made use of this method in an enormous number of cases, always with good results and the practice has been followed by many practitioners who have visited his clinic. While there is no doubt that the method must have been in use before the boilermaker discovered it, earlier reference to it seems to have escaped attention, except that the water from certain springs which is almost as free from lime as is distilled water has been used as a prophylactic against recurrence of renal stone from time immemorial.

Treatment of Bladder Tumors in Women.—KELLY (*Am. Jour. Obst.*, 1919, lxxx, 328) has been making an investigation to determine how best to approach and to deal with vesical papillomata and infiltrating cancers of the bladder wall not yet extensive. Before the days of cystoscopy a certain diagnosis of cancer or papilloma could not be made in the early stages and there was no such recourse as any real surgery of the bladder, beyond a mere incision and drainage for cystitis. Then came the era of free suprapubic openings of the bladder, followed by more or less extensive extirpations, with their too frequent recurrences, and now at last with our greater experience and greater familiarity with the diseases of the bladder and better methods of diagnosis he believes it is time to inaugurate also other yet better methods of treatment, and to hark back in some cases at least to more conservative procedures. According to Kelly, direct vision and direct accessibility through the air-distended bladder is the simplest, speediest and most effective way of reaching intravesical lesions, while fulguration is the most rapid way of destroying pedunculate and limited isolated lesions and is often permanently effective, although it utterly fails in many cases of dissemi-

nated lesions. It always fails in cases of infiltrating lesions and usually aggravates them, but radium is available and successful in all classes of cases and is especially of value in the group where fulguration fails. Radium should be applied directly under inspection to lesions in substantial dosage, say 250 mc. hours per month to an area 2 cm. square and experience has shown that it is better to apply radium in broken dosage, weekly, following and controlling results. It is best applied intravesically when it reaches the part in concentrated form without the risk of hurting the vagina incurred when the treatment is given through the vaginal wall. With the means now at our disposal of using these newer and most effective agencies in the treatment of vesical tumors by the direct open channels of the dilated urethra and air-dilated bladder, the treatment of vesical neoplasms enters upon a new phase of greater hopefulness and our effectiveness as urologists is greatly enhanced in dealing with these fairly common, distressing and formerly often fatal maladies. Kelly cautions that extreme watchfulness is necessary at three stages in all vesical neoplasms: (1) It is of the utmost importance to get the case under examination and treatment at the earliest possible moment. This can only be done by investigating at once and tracing to its source the slightest urinary hemorrhage. (2) When under treatment the case must be watched over a period of several months or longer until all trace of the disease has disappeared. (3) All these cases require watching at intervals of at first a few weeks and then of months for several years in order to catch any recurrence at an early stage.

OPHTHALMOLOGY

UNDER THE CHARGE OF
EDWARD JACKSON, A.M., M.D.,
DENVER, COLORADO,

AND
T. B. SCHNEIDEMAN, A.M., M.D.,
PHILADELPHIA.

Tonometric Values.—PRIESTLEY SMITH (*British Jour. Ophthal.*, July, 1919, p. 293) concludes that the Schiötz tonometer measures the impressibility of the eye and can indicate changes of intra-ocular pressure in a given eye with great certainty. For example, it has proved (See McClean's experiments) that in animals and in man, and in glaucomatous as well as in healthy eyes, the intra-ocular pressure falls considerably during ether anesthesia. The tonometer cannot measure the intra-ocular pressure with precision because the relation of the impressibility of the eye to the intra-ocular pressure is different in different eyes; in other words, exact mercury equivalents for the degrees indicated by the pointer cannot be given. Approximate mercury equivalents are found by testing a number of human eyes with the tonometer and a manometer almost simultaneously. It is not possible, however, to carry out

the test under conditions quite like those under which the tonometer is ordinarily used. Equivalents found by experimenting on animal eyes are likely to be incorrect for human eyes. The value of any new tonometer will depend not merely on the excellence of its mechanism, but also and essentially on the tests by which it was regulated. Full details of the method and the results should be given. The Schiötz curves are not likely to be precisely correct, even for the average living eye for the reason just given. They are necessarily sometimes at fault for the individual eye. On the other hand it is not proved, and it is not likely, that the instrument errs to the extent that McClean's experiments suggest. (McClean's paper appeared in the *Arch. Ophthalm.*, 1919, p. 23).

Syphilis and Irregularity of the Pupil.—DUJARDIN and RASKIN (*Annal d'Oculistique*, January, 1919, p. 89) from the study of a series of cases of irregularity of the pupil, conclude that such irregularity is a very frequent symptom in syphilitic infection. It is most common during the secondary stage; from thence onward it tends to become complicated with other disturbances of the pupil, although the irregularity may be the sole pupillary phenomenon in advanced syphilis. Reciprocally irregularity of the pupil in at least 70 per cent. of the cases is of syphilitic origin. Accordingly every case of irregularity of the pupil should be examined serologically and if this is negative by lumbar puncture.

Affections of the Lacrimal Passages.—LANDOLT (*Archiv. d'Oftal. Hispano-Amer.*, November, 1918, p. 544) maintains that probing does not cure. It simply prepares the way for medicaments. The canaliculi should not be disturbed whenever possible; if dacryocystitis necessitates incision, the upper should be selected. Where irrigation with solutions of sulphate of zinc, nitrate of silver, etc., do not suffice, both canaliculi should be slit and the two incisions united by scissors; this procedure will cure dacryocystitis even when complicated by fistula. The sac should never be opened from the anterior wall; it can be cauterized by introducing the mitigated stick of silver nitrate, neutralizing the excess with chloride of sodium. These applications may be repeated and occasionally replaced by the pure nitrate. Vacher injects into the suppurating sac a few drops of chromic acid, 1 to 50. The eye-ball must be well protected and also the palpebral conjunctiva with cotton saturated with a weak solution of oxygenated water in isotonic serum, first irrigating the sac and injecting a solution of cocain 1 to 10. To reëstablish the permeability of the canal, Vacher introduces and leaves in place, sometimes for several months, a fine silver wire, 1 to 1½ mm. in diameter; curving the upper end is sufficient to hold it in place. This method of cauterization will almost always avoid the necessity of extirpating the sac, an operation which has been greatly abused.

Jaw-winking and Its Explanation.—Under the name of "jaw winking" is understood the curious and very striking appearance of retraction of the upper eyelid during movements of the jaw, face, pharynx and tongue. Since the first description by Marcus Gunn in 1883, there have appeared about 90 observations in the literature. LUTZ (*Arch. Ophthalm.*, March, 1919, p. 144) rejects the explanations

hitherto advanced, but thinks that the phenomenon is produced by alterations of the supranuclear connection of the bulbar nuclei in the fasciculus long. post., and probably by a lesion of the inhibitive mechanism, just before the dendrites of the damaged nuclear cells. The palsy of the other eye muscles, which so often accompanies the jaw-winking phenomenon, is then caused by lesions of the nuclei themselves, or of the last unilateral part of the afferent or efferent fibers.

Correction of Keratoconus.—EPERON (*Annal. d'Oculist.*, April, 1919, p. 226) treats of correction of keratoconus by Müller's shells. Javal's ophthalmometer will measure the optical effect of these shells when their posterior surface is covered with varnish or gelatine; at the same time, Eperon has found, in trials upon human eyes that the refraction of these shells is generally inferior by several diopters to the reading of the ophthalmometer. This is due to the fact that the posterior surface of the shells is more curved than the anterior so that the shell acts like a divergent meniscus. Eperon uses an artificial eye with Müller's shells for cornea and thus measures directly by skiascopy with water as the posterior medium. In this way he has been able to show that, beside their insufficient refractive power, the shells have other defects, notably astigmatism, usually oblique, and also a conical deformation affecting at least one-quarter of the samples investigated. These shells are better tolerated than Sulzer's contact glasses, and much more satisfactory from the optical standpoint, although it is to be hoped that they may be improved as regards this point. It is possible to correct by them not only keratoconus and irregular astigmatism but also high myopia as well as aphakia.

Three Cases of Gas Infection of the Cornea.—PRINGLE (*British Jour. Ophthalm.*, March, 1919, p. 110) reports 3 cases of gas infection of the cornea, following gunshot wounds of the eye. One of the most striking features in these 3 cases was the rapid involvement of the cornea. In each it was only a matter of a few hours, while in the last case the upper third of the cornea became infiltrated in forty-five minutes. It would appear as though it were necessary to have some break in the corneal epithelium and possibly in Bowman's membrane, before the gas organisms can gain access to the corneal substance. In the first 2 cases, this break was caused by actual wounds of the cornea, and in the last case by an ulcer following exposure of the cornea. In each case the eye was removed while the cornea alone was involved; it would have been extremely interesting to note the spread of the infection. The pathological report showed that only streptococci and staphylococci were isolated from the contents of the globe and that beyond inflammatory reaction, the sclera showed no signs of actual gas infection. It is probable that the sclera would offer considerably more resistance to the development of gas organisms than a damaged cornea. As streptococci and staphylococci were isolated from the iris and vitreous, infection had evidently spread through Descemet's membrane which had become disorganized, into the interior of the globe and whether or not the blood supply to the iris and ciliary body had anything to do with the barrier offered to the inroads of the gas organism in this direction, can only be conjectured.

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF

OSKAR KLOTZ, M.D., C.M.,

PROFESSOR OF PATHOLOGY AND BACTERIOLOGY, UNIVERSITY OF PITTSBURGH,
PITTSBURGH, PA.

(1) The Oxygen of the Arterial and Venous Blood in Pneumonia and its Relation to Cyanosis. (2) The Oxygen and Carbon Dioxide Content of Arterial and of Venous Blood in Normal Individuals and in Patients with Anemia and Heart Disease. (3) Studies of Cyanosis. (I) Primary Causes of Cyanosis, (II) Secondary Causes of Cyanosis, (III) Erythrosis, or False Cyanosis.—The grouping of five recent studies of the blood gases in a variety of conditions, with especial reference to cyanosis, virtually constitutes a monograph on the subject. These papers, in that they are so closely related, may well be reviewed together. I.—STADIE (*Jour. Exper. Med.*, 1919, xxx, 215), impressed by the unusual frequency and intensity of the cyanosis of influenzal pneumonia, investigated the blood gas content in five normal individuals and in 33 patients with pneumonia. In the course of this work, he perfected a simple technic for arterial puncture. On normal subjects, the arterial unsaturation (the value indicating the difference between the actual and the possible oxygen content of a given specimen of blood) was found to be 5 per cent. of the total oxygen capacity. The venous unsaturation was 26.8 per cent. of the total oxygen capacity. In pneumonia, there was a great variation in findings. The arterial unsaturation ranged from 0.0 per cent. to 68.2 per cent., the venous from 14.4 per cent. to 85.5 per cent. It was generally found that an arterial unsaturation of over 20 per cent. was associated with the fatal outcome. The mean arterial unsaturation in fatal cases was 32 per cent. against 13.9 per cent. in the non-fatal ones. The venous unsaturations correspondingly averaged 57 per cent. and 36.3 per cent. Patients without cyanosis showed an arterial unsaturation very close to the normal, the mean figure being given as 5.4 per cent. A definite relation exists between arterial unsaturation and the appearance of cyanosis. The more marked the cyanosis, therefore, the greater is the degree of arterial unsaturation. Hence, the deduction is made that cyanosis in this type of pneumonia is due to incomplete oxygenation of venous blood in the lung. As the oxygen capacity was found to be even slightly higher than the normal (indicating a concentration of the blood) methemoglobinemia in the cases studied, was evidently a negligible factor. Stadie points out that none of the patients could be considered true lobar pneumonia so that this is not evidence against the possible occurrence of methemoglobin formation in that condition. Oxygen consumption, estimated as the difference between arterial and venous oxygen content, was not below normal limits; this indicates that the cardiac output is not diminished in influenzal pneumonia, thus corroborating the postmortem finding in regard to the heart. II.—HARROP (*Jour. Exper. Med.*, 1919, xxx, 241) studied a group of 15 normal individuals, in whom he estab-

lished the oxygen unsaturation of arterial blood at 4.5 per cent. a figure closely corresponding to that found by Stadie. No difference in arterial oxygen content was found at diverse points in the peripheral circulation. The blood, therefore, suffers practically no alteration in passage from the lung to the terminal arterioles and capillaries. This adds force to Stadie's point regarding cyanosis as an evidence of incomplete oxygenation of the blood leaving the lesser circulation. The normal individual after exercise showed lowered oxygen saturation, and at the same time, lowered carbon dioxide content of the arterial blood. In anemic patients, the arterial oxygen saturation was normal. The venous blood, however, showed low absolute value for oxygen content. But the oxygen consumption was maintained at normal. Cases of heart disease, without evidence of change in lungs, and at rest in bed, showed normal blood gas findings. The pernicious effect of lung involvement in connection with heart disease, resulting in interference with gaseous interchange, and the relation of this complication to cyanosis, is well brought out in a series of estimations on patients with cardiac decompensation and pulmonary changes. Patients with decompensation exhibited a marked degree of arterial unsaturation, which tended to return to normal as compensation was reestablished, but only did so when the pulmonary lesions cleared up. A marked degree of arterial unsaturation was accompanied by an increase in oxygen consumption and as the degree of arterial unsaturation became less so was the oxygen consumption lowered toward the normal. These observations are entirely in accord with those of Stadie, pointing as they do to a pulmonary basis for the alteration in blood gas content. III.—LUNDSGAARD (*Jour. Med. Res.*, 1919, xxx, 259, 271 and 295) states, as the result of the analysis of venous blood in a considerable group of individuals with and without cyanosis, that neither increased carbon dioxide content of venous blood, nor low absolute oxygen content of venous blood has any relation to the clinical finding of cyanosis. He believes, rather, that increase of oxygen unsaturation of venous blood (*i. e.*, the presence of a difference greater than normal between the oxygen actually present in the venous blood and the total oxygen combining power of that blood) is the primary cause of cyanosis. As Lundsgaard has previously demonstrated, the normal resting individual never shows an oxygen unsaturation in the venous blood greater than 8 volumes per cent. This is interesting in view of the finding that among the patients with cyanosis, none showed a venous oxygen unsaturation below the figure just named. Apparently, then, at least this degree of unsaturation must be attained before cyanosis is possible as a clinical finding. But this does not mean that cyanosis invariably occurs at this point. A further study of the findings shows that only in event of a venous oxygen unsaturation of 13 volumes per cent. or greater was cyanosis always present. Why venous oxygen unsaturation up to 13 volumes per cent. may be found without cyanosis is explained by Lundsgaard on the basis of oxygen saturation of the arterial blood reaching the capillaries from the lungs. If this blood is completely saturated, a venous oxygen unsaturation of 13 may be reached before cyanosis appears. But if the arterial blood is not saturated with oxygen, cyanosis develops more readily, appearing with a venous oxygen unsaturation of 8 volumes per cent. The degree of arterial unsaturation in

cyanosis may thus be estimated from the degree of venous unsaturation present. Pulmonary disorders, as a rule, give rise to oxygen unsaturation, and are to be suspected even in absence of physical signs. The principal secondary cause of cyanosis, then, is a partial reduction (or incomplete oxygenation) of arterial blood going to the peripheral circulation, resulting from interference in gaseous interchange by some affection of lung and heart. Another secondary cause is decreased oxygen tension in the alveoli, as occurs in high altitudes. The second important secondary cause of cyanosis is increased reduction of the blood during its passage through the capillaries as in active physical exertion, and accompanying the retarded blood flow of decompensated heart lesions. Finally, Lundsgaard has studied the venous blood of a patient having the condition named erythrocythemia rubra vera by Osler. Here the normal oxygen unsaturation was found, though the hemoglobin and the total oxygen capacity were abnormally high. The carbon dioxide content was normal. By reason of the curious brick-red dusky color of the skin (false cyanosis), the term "erythrosis" is proposed as the name of the condition. This would seem to be no improvement on the former name, since it is less descriptive of the condition.

Contribution to Predisposing Factors in Pulmonary Tuberculosis.—

Various views are held upon the direct and indirect influence of artificial pneumothorax upon the progress of tuberculosis in the human. Some have claimed that the collapsed lung is subject to a condition of venous stasis which is antagonistic to the progress of a tuberculous infection. SHAW (*Am. Rev. Tuber.*, 1919, iii, 410) in a limited number of animal experiments comes to conclusions at variance with the above conception. The production of artificial pneumothorax followed either by intravenous inoculation or intratracheal inoculation of tubercle bacilli was followed by the development of tuberculous lesions within the collapsed lung, while the lung of the opposite side remained free. He suggests that these findings should receive consideration in the analysis of spontaneous human infection.

Primary Spontaneous Tumors of the Testicle and Seminal Vesicle in Mice and Other Animals.—

Tumors of the testicle in lower animals seem to be very rare as very few instances can be found in the literature. Those reported have occurred for the most part in horses and dogs. There is not a single instance of such a tumor occurring in mice. The authors, SLYE, HOLMES and WELLS (*Jour. Cancer Res.*, 1919, iv, 207) can add from their series of 19,000 autopsies on mice dying natural deaths, 28 instances of primary tumor of the testicle. Most of these resemble the human tumor in every respect being composed of epithelial cells closely resembling those of the seminiferous tubules and arranged in an alveolar structure. The tumors are usually very vascular with large blood channels, the walls of which are often composed solely of tumor cells. Cells with atypical and giant nuclei are common and multinucleated cells are often found. For the most part these new growths of the testis are essentially benign in character, developing very slowly, rarely ulcerating, generally distinctly limited by the tunica albuginea and in no case with distinct remote metastases. One case presented a series of six contiguous independent nodules and one case showed

bilateral testicular tumors. Two of the growths resembled typical spindle-cell sarcoma, one arising at the site of a wound. Three of the so-called orchidoblastomas followed trauma. There was no evidence that any of these neoplasms had arisen in a teratomatous growth and no true teratomas were observed, this in direct contrast to the frequency of teratomas in the human testicle. With the exception of one tumor all the 28 neoplasms of the testis in mice occurred in members of a single strain of mice and its hybrid derivatives, thus bearing out the theory that heredity influences the incidence of tumor development in different organs or tissues. This fact may account for the absence in the literature of recorded cases of tumor of the testis in mice from other laboratories. As for tumors of the seminal vesicles the authors found one case of polymorphous-cell sarcoma, apparently only the second case on record of such a growth in the seminal vesicle of a lower animal.

Cancer in Hainan, China.—It is generally agreed that cancer is a disease occurring after middle life and due to a variety of causes but despite an almost innumerable list of possible contributing factors the subject still remains an unsolved problem. BERCOVITZ (*Jour. Cancer Res.*, 1919, iv, 229) has found in studying the disease among the Chinese a number of phases differing from those usually encountered. It must be noted that medical conditions in China are very different from those of the western world and may account in a large measure for the differences which the author found. Many cases do not come to the hospital until inoperable and only after all native remedies have failed. Until very recently prejudice has kept women away from medical and surgical aid. A striking point of difference which the author offers without being able to give any explanation for it is that cancer in China is as much a disease of the early decades of life as of the later. Of 131 cases of cancer 50.3 per cent. occurred before the age of forty. The most frequent locations of malignant growths are the penis, skin and cervical glands. The only reasons to be assigned for these sites are the high incidence of syphilis among the Chinese male population and attempts to cure the primary lesion by the application of highly caustic native remedies. Counter-irritation is extensively practiced by the Chinese to drive out evil spirits supposed to be the cause of disease. Moreover the Chinese are as a rule very scantily clad. The arms, trunk and legs of the men who work in the fields being bare, the rays of the sun may be a contributing factor. The author is unable to explain the great frequency of cancer of the cervical glands unless perhaps through infection from the throat since in most cases there are no marks on the neck to indicate previous counter-irritation. The author notes the infrequency of cancer of the stomach and of the uterus. For the former he offers the explanation that certain virulent streptococic infections which according to Rosenow are responsible for gastric ulcer are not found among the people of Hainan. Infections due to streptococci, as scarlet fever, appendicitis and acute articular rheumatism (non-gonorrheic) are practically unknown in that part of China. The only reason to be given for the infrequency of cancer of the uterus is the one noted above that until very recently women have not sought medical aid. It is rather suggestive, too, that the virulent infections of the female generative organs seem to be infrequent among the Chinese.

HYGIENE AND PUBLIC HEALTH

UNDER THE CHARGE OF

MILTON J. ROSENAU, M.D.,

PROFESSOR OF PREVENTIVE MEDICINE AND HYGIENE, HARVARD MEDICAL SCHOOL,
BOSTON, MASSACHUSETTS,

AND

GEORGE W. McCOY, M.D.,

DIRECTOR OF HYGIENIC LABORATORY, UNITED STATES PUBLIC HEALTH SERVICE,
WASHINGTON, D. C.

Influenza in Three Chicago Groups.—JORDAN (*Public Health Reports*, 1919, xxxiv, 1528) summarizes the result of his studies as follows: With respect to age the figures show a higher attack rate among the pupils of the university elementary school (ages four to thirteen) than among those of the high school (ages fourteen to eighteen); the teachers in these schools had a lower attack rate than the pupils. Apparently a definite selective age incidence is manifested since the pupils in these schools are from the same section of the city and to a large extent from the same families, and were presumably exposed in similar degree. With respect to sex there was no noteworthy difference among the pupils in the high and elementary schools (attack rates, 230 for boys, 231 for girls). It is fair to assume that the chances for acquiring infection were substantially the same for these children and that one sex was as much exposed to infection as the other. Among the employees of the Chicago Telephone Company, on the other hand, the men were affected in considerably lower proportion than the women (151 per 1000 for men and 233 for women). Probably the age factor was largely responsible for this difference, since the women employees are of a much lower average age than the men. Illness reported under the heading of "Colds," etc., seems to have been at a considerably higher level during the autumn of 1918 than during the corresponding period of 1917. This was particularly the case among the pupils of the university schools and to a somewhat lesser degree among the employees of the Chicago Telephone Company. Comparison of the reported cases of influenza and colds in the latter group for the months of September and November suggests that some cases of influenza were reported under the former heading. The differing degrees of incidence in the various groups here considered are specially striking. The attack rate among the employees at the various Chicago telephone exchanges ranged from 30 to 270 per 1000, although the working conditions in the several exchanges were not materially different. The highest attack rate recorded for any group occurred among members of one section of the Student Army Training Corps at the University of Chicago (398 per 1000), while the lowest (39 per 1000) was among the members of the other section of the same corps. The former group was particularly exposed to infection, while the latter, although composed of men of similar ages, living under substantially similar conditions with those of the first group, were guarded to a considerable extent against contact with beginning cases. The

data obtained in regard to the schools apparently indicate that the schools were not important distributing centers for the infection. No explosive outbreak occurred in any one grade, and the four days of the Thanksgiving holiday evidently afforded more favorable opportunities for infection than did the days of regular school attendance. The low pneumonia incidence and the absence of deaths among the pupils of these schools (188 cases) is noteworthy. The influence of careful supervision of a somewhat segregated group of individuals is shown by the low attack rate in section A of the Student Army Training Corps.

The Occurrence of Malaria Parasites in *Anopheles Crucians* in Nature.—MAYNE (*Public Health Reports*, 1919, xxxiv, 1355) reports that *Anopheles crucians*, which a few years ago was established as an efficient host for the malaria parasites under experimental conditions, has been found infected in nature, a single specimen having come under his observation among 20 examined, while 17 infected *A. quadrimaculatus* were found among 709 examined.

***Anopheles Crucians* Wied. as an Agent in Malaria Transmission.**—METZ (*Public Health Reports*, 1919, xxxiv, 1357) made observations on the habits of *Anopheles crucians*, with reference to the probability of this species transmitting malaria, and found that it is not often present in dwellings unless the species is very prevalent but it is very common in privies. He found about as high a percentage of infection among *Anopheles crucians* as among *Anopheles quadrimaculatus*. Metz's conclusions are as follows: It is believed that the data given above leave no doubt as to the susceptibility of *Anopheles crucians* to infection with malaria plasmodia under natural conditions. Likewise, they indicate that, although the habits of this species are probably less conducive to natural infection than are those of *quadrimaculatus*, nevertheless a considerable amount of infection occurs. This evidence of *crucians*' susceptibility of infection in nature, taken in conjunction with the demonstration of its infectivity; *i. e.*, its role as a vector, under laboratory conditions (Mitzmain, 1916 (a), King, 1916), would indicate that this species is potentially of definite sanitary importance. The evidence is too meager, however, to indicate the degree of importance it merits as compared with *quadrimaculatus* and *punctipennis*. Considering its habits, it seems probable that *crucians* is primarily an out-of-door biter, *i. e.*, it is probably most effective on porches and in outhouses. If such proves to be the case, especial precautions against out-of-door exposure in the evening will be necessary in *crucians* infested districts, whereas screening of dwellings will be relatively unimportant except where other species must also be considered.

The Epidemiology of Influenza.—FROST (*Public Health Reports*, 1919, xxxiv, 1823) reviews the course of the epidemic in the United States in a manner that does not permit of satisfactory abstracting, but the views of the author on several points are of such great interest as to justify special mention: The data indicated that one attack confers immunity against a second one, at least for a period of several months. The general characteristics of the epidemic are similar to those of the 1889-1890 epidemic, but there was a higher frequency of pneumonia and a

higher mortality, especially among young adults. The disease is believed to be spread "directly by contact, in the broad sense." As to the probability of recurrence, the author points out that previous experience leads us to expect this, but as the epidemic of this past year has been unusually severe and has shown several distinct phases, we have some ground for hoping that it has probably run its course.

The Malaria Problem of the South.—CARTER (*Public Health Reports*, 1919, xxxiv, 1927) stresses the fact that mortality statistics give no adequate indication of the great economic losses chargeable to malaria. He states that each death from pneumonia corresponds to about 125 days' illness; one from typhoid fever 450 to 500 days, while one from malaria corresponds to 2000 to 4000 sick days. The amount of malaria may be as high as 90 per cent. of the population and 40 per cent. to 60 per cent. is not unusual, and this fact is rapidly and certainly reflected in economic conditions. The area of severe prevalence is lessening, due largely to improved economic conditions and to reduction in the price of quinin. The following methods of control are described and their applicability indicated: (1) Get rid of *Anopheles* mosquitoes—no other kinds make any difference in malaria; (2) prevent the access of *Anopheles* mosquitoes to man; (3) free all persons in the community from malaria parasites; (4) protect persons against infection by means of quinin.

Occupation and Mortality.—WYNNE and GUILFOY (*Public Health Reports*, xxxii, 885) show that in New York, in 1914, the relative mortality from pulmonary tuberculosis was lower among blacksmiths, considered as a group, and also in each age group, than the average relative mortality from the same cause, of all occupied persons over fifteen years of age. Clerks, bookkeepers, office assistants, etc., had a mortality from the disease almost twice that of all occupied persons over fifteen years of age, while cigar-makers and tobacco-workers had a mortality 25 per cent. above the average. Garment workers' mortality from pulmonary tuberculosis compared favorably with that of all occupied persons, while that of laborers ranked next to bookkeepers and clerks' mortality from the disease. The tuberculosis mortality for machinists was higher than the average, as was that for painters, paper-hangers, varnishers, etc. Among railway track and yard-workers and saloon-keepers the mortality from the disease was not greatly in excess of the average. The mortality from tuberculosis among teamsters and drivers was so much above the average as to attract special attention; it is believed to be largely due to the high incidence of alcoholism. Cancer mortality was high among those engaged in sedentary occupations and low in the occupations requiring active physical labor. Mortality from cancer was low where that from tuberculosis was high. It was lowest among teamsters and drivers, among whom tuberculosis was highest. The highest percentage of deaths from alcoholism occurred among saloon-keepers and bartenders, with that of laborers next. Organic heart disease mortality was low for blacksmiths, printers, varnishers, painters, paper-hangers, teamsters, railway track and yard employees and laborers, and very low among clerks, bookkeepers, office assistants, etc., and saloon-keepers. It was high among cigar-

workers and garment-workers. The mortality from nephritis was above the average among blacksmiths, garment-workers and cigar-workers. It was low or close to the average among those engaged in the other occupations. The mortality from lobar pneumonia was above the average among blacksmiths, clerks and bookkeepers, teamsters, laborers, track and yard workers, saloon-keepers and compositors and printers, especially among the latter. Mortality from the disease among painters and paper-hangers, machinists and garment-workers was not excessive. The pneumonia mortality for tobacco workers was very low. The highest mortality from cirrhosis of the liver was among saloon-keepers. Occupation appeared to have no bearing in other cases. Mortality from suicide was highest among cigar-makers, garment-workers and saloon-keepers. The majority of deaths from lead-poisoning occurred among painters. Mortality from accident was higher than the average among blacksmiths, laborers, machinists, painters, paper-hangers, teamsters and railway track and yard workers, the highest being among the latter. Poorly ventilated shops accounts for the high mortality from respiratory diseases among clerks, bookkeepers, etc., and printers and compositors. The low mortality from pulmonary tuberculosis among garment-workers is explained by the racial immunity and the manufacture of clothing in the homes. Inasmuch as mortality from cancer is uniformly lower in strenuous occupations, there appears to be some relation between the disease and occupation. The unduly high mortality from heart and Bright's disease among tobacco-workers and garment-workers cannot be entirely explained by the advanced age of the occupants. Alcohol appears to be an important hazard among saloon-keepers. The pneumonia hazard seems to be greatest among those grouped together in offices and shops and among those alternately exposed to high and low temperatures.

The Dust Hazard in the Abrasive Industry.—WINSLOW, GREENBERG and GREENBURG (*Public Health Reports*, 1919, xxxiv, 1171) state that exposure to mineral and metallic dusts is accompanied by excessive tuberculosis ratios. The small, sharp, hard, non-absorptive particles are the most dangerous ones. The inhalation of these leads to an initial fibrosis which leads in many cases to the development of pulmonary tuberculosis. The manufacture of abrasive materials is, by its very nature, exceptionally hazardous. Examinations of the dust at various parts of abrasive factories showed varying and often large numbers of particles, and this is true even of offices and out of doors near the factory. Suggestions are made looking to the reduction of the dust hazard in the abrasive industry.

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All communications should be addressed to—

DR. GEORGE MORRIS PIERSON, 1913 Spruce St., Philadelphia, Pa., U.S.A.

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